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Morton Githens Lloyd.....Technical Editor
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FRANCHISE VALUE IN NEW JERSEY.

In the issue of December 19, 1914, we raised the question as to whether the regulation of public-utility rates in the state of New Jersey had come to an end. This was occasioned by the action of the Court of Errors and Appeals in that state in setting aside the decision of the Board of Public Utility Commissioners in the Passaic Gas case after the same had been affirmed by the Supreme Court of the state. The decision referred to fixed the rate for gas supplied by the Public Service Gas Company in the Passaic Division at 90 cents per thousand cubic feet.

The decision of the Court of Errors and Appeals was based solely on the question of franchise value. This court held that such value existed and therefore should be included in a valuation for rate-making purposes. The Utility Board had made an allowance of 30 per cent over the physical value for intangibles, but had not made any specific allowance of more than nominal amount for the value of the franchise. Although the Supreme Court had upheld this position and although a statute prohibited the capitalization of franchise value, the rate was set aside on this ground. A rehearing of the case was granted, however, and a decision on the rehearing was handed down last week.

The latest decision reverses the previous attitude of the court, and affirms the decision of the Supreme Court, from which appeal had been taken. The position of the Board of Public Utility Commissioners is thus upheld and the rate fixed will stand after all.

This decision means much for rate regulation in New Jersey. As pointed out in the former editorial, the previous decision of the appellate court was a knockout blow for rate regulation in that state, if permitted to stand. Its logical result would have been to prevent any lowering of rates by the Board, and its effect was evidently in contravention of the expressed intention of the law-making power. Under it, the Board would have been helpless in rate matters, and any control over rates would have had to be sought by other means. The new decision, however, strengthens the Board in its policies and its power, and will permit the development of commission regulation to proceed in the state of New Jersey. While an intention has been expressed of carrying an appeal to the federal courts, there is little likelihood that the United States Supreme Court would upset the present decision, judging by previous cases which have come before it and by the present constitution of that court.

ARTIFICIAL DAYLIGHT.

The application of artificial light which shall have the same quality as daylight, that is to say, the spectral composition of which is equivalent to daylight in the effect upon the eye, has received much attention recently. This is due largely to the deeper investigation and consequent development of absorbing glasses which have the necessary properties, and also to the development of light sources whose efficiency is so far in advance of previous values as to make the absorption of a considerable percentage of the light by some absorbing medium permissible.

It is universally recognized that artificial daylight is a very great assistance in carrying on work where the matching of colors or other estimates of color values must be made. In fact a great deal of such work could heretofore be done only during daylight hours. For such work it is necessary not only that light of a constant quality be available, but this quality must approximate very closely to that of daylight in order that effects obtained and estimates made under the artificial light shall not become useless when the materials are observed in actual daylight.

Whether simulated daylight is desirable under other circumstances is a mooted question. There are many who claim that it is not to be chosen over more common illuminating media, most of which have a preponderance of yellow light. In considering this desirability a clear distinction should be made between utilitarian and esthetic or artistic effects. The human eye has been evolved to meet the conditions of daylight and it is generally recognized that the eye functions better under such lighting conditions than under the stimulus of colored light. But one exception is to be made to this statement, and that refers to the fact that chromatic aberration is avoided and visual acuity is greater by the use of monochromatic light; but if light of mixed composition is to be used, that which most closely simulates daylight must be given preference from the standpoint of utility. Consequently, artificial daylight may be regarded as an improvement over these yellow illuminants in workshops and many other places where first consideration is given to utilitarian conditions.

When we come to consider the lighting of homes, auditoriums, churches, and other places of public assembly and a certain class of offices, the question of the best condition for seeing will no longer be permitted to dominate the decision as to the quality of light which shall be used. In these places an esthetic and artistic effect will no doubt be given the greatest weight. We are involved then with the psychological influence of lights of different color, and no doubt in the main preference will be given to a preponderance of yellow light not merely because we are habituated to this difference in artificial lighting, but because light makes a distinct impression upon the individual which is dependent upon the color. Emotional influences are undoubtedly involved in this matter in a way that depends upon more than mere cultivation of the taste, and the preponderating verdict seems to be in favor of the older illuminants.

RESEARCHES ON INSULATING MATERIALS.

Two interesting articles on the properties of insulating materials have appeared in the current volume of the *Elektrotechnische Zeitschrift*. The authors, Messrs. F. Kock and K. W. Wagner, not only give constants resulting from their measurements of different materials, but point out certain properties belonging to certain classes of materials.

The dielectric strength of liquids, for instance, is found to vary with the pressure to which they are subjected according to a linear relation; in other words, the normal strength is increased under pressure by an amount which is proportional to the pressure. Solids, on the other hand, show no influence of pressure on the dielectric strength, at least within a range of 50 atmospheres.

The thickness of the test specimen has little or no influence upon the dielectric strength in the case of liquids. The effect of the time element, however, is one which must be considered, as observed by previous experimenters.

The researches of Mr. Wagner were confined to solid insulating substances and concerned mainly the dielectric constant, insulation resistance, and ability to absorb energy when subjected to alternating electric stress. A pronounced dielectric hysteresis was found in such materials as rubber and gutta-percha; while in hygroscopic substances like paper and cotton there was superposed upon this an effect similar to conduction, but which does not appear to follow the simple laws of conduction in ordinary conducting materials. This effect was fully explained in a paper by Mr. S. Evershed, which will be found in our issue of December 20, 1913.

Gutta-percha shows a maximum absorption of energy, at ordinary temperatures, the values decreasing as the temperature increases. Certain other compounds show a reverse effect, with much lower values at ordinary temperatures, and it may be concluded that such substances would be preferable for telephone cables or others where energy absorption is important, but less suitable for power cables or others liable to attain a high temperature. For telephone work, however, all such materials are avoided as far as possible, loose paper with entrained air having proved more suitable.

The dielectric constants (or specific inductive capacities) of the rubbers increase with the temperature, but that of paraffin, on the other hand, decreases with increasing temperature. The energy absorption of paraffin showed a minimum at about 50 degrees centigrade.

Insulating materials are undoubtedly the least well known and their behavior is the least understood of all the materials with which the electrical engineer has to deal. Every investigation which adds to our knowledge of them is to be welcomed.

INSTALMENT PURCHASES OF ELECTRICAL EQUIPMENT.

When the history of electrical development is written from the viewpoint of pure commercialism, as it is some day bound to be, few factors will count for more in the story of appliance popularization than the adoption of the instalment plan of purchase. It will be seen that the leaders in the central station and supply industry recognized in the early part of the present century that the only way in which the obstacle of a substantial first cost could be overcome was by allowing time payments on equipment used in home and shop. In other words, the day came when the spread of electrical service among the people everywhere became a matter of credit, and to the enduring reward of the larger-minded men in the industry, the instalment system solved the problem.

Now the thing has gone so far that not long ago a central-station manager was heard to say publicly that his company stood ready to see to it that the people in his city became users of electric trucks on the basis of time payments, the first cost being guaranteed by the electric service company in cases where the prompt payment of the price of these machines was regarded as too heavy a burden for the local merchants and manufacturers.

There is no question that the privilege of time payments, which has embraced apparatus as small as electric irons in its widening scope of application, goes a long way toward justifying the maintenance of full retail prices by central stations. This means fairer relations with the contractors and jobbers, and tends to do away with much of the apparent need of cutting down the legitimate profits of the business of appliance merchandising in order to encourage the public to buy electrical conveniences.

In the business world, the first cost of an article is a secondary consideration, once it can be shown that its purchase will pay for itself in due season, all costs being taken into account. Similarly, first cost is a minor matter in homes, provided the terms of payment are made sufficiently easy and extended to enable small but regular refunds to be made. Many a man would never buy a piano if he were obliged to lay down $450 to $600 in actual cash before the instrument could be delivered, and many a householder would never buy an electric range if the local electric service company or the supply dealers in town refused to allow her to carry the load along, gradually reducing the indebtedness and meanwhile having the use and pleasure of the equipment.

Some companies are arranging to supply motors for trial installations on the instalment basis, and if the terms of the agreements are properly figured to care for interest, insurance and other charges, surely it is good business practice, and certainly is working out admirably in operation. The electrical industry is fast coming to see that the problem of getting equipment upon the lines and keeping it in service is the main thing to solve, and valuable as are cash methods of doing business, and effective as are occasional low-price campaigns in drawing public patronage, the master minds of electrical commerce are turned in the direction of stimulating the use of equipment by easy-payment methods. Every reason why instalment purchases are profitable in general merchandising applies to the electrical trade.

THE CONVENIENCE OF LOW-POWERED LAMPS.

There seems to be no end to the application of incandescent lamps of low candlepower, and yet the field of usefulness for these is barely scratched. There is no doubt that the near future will see a decided advance in this interesting branch of lighting practice, notably in industrial lines of service. The improved lighting of all sorts of machinery may be expected in this connection, in view of the great increase in production and reduction in eye strain which follow localized illumination of the working field. The development of a two-candlepower lamp for use on electric flat irons is a hint of these good things to come, as is the work now being done toward bringing out a tiny pilot lamp suited to industrial sewing-machine-needle service. The automobile of today is using low-powered lamps in ways which need not be repeated here, except to mention a recent convenient application in a touring car consisting of the installation of a small lamp and bull's eye in the rear of a swivel seat, the lamp being so placed that by pressing an ivory button in the seat back, a well directed stream of light is thrown upon the car floor and the rear step and ground behind and below, cutting off danger of accident due to insufficient side lighting, and also affording an attractive means of consulting time tables, road maps, etc. With the intermittent service needed from many miniature lamps, nothing ought to stand in the way of their greatly increased use, and the cost is trifling in proportion to the benefits.

WIRING SPECIFICATIONS.

Many requests have come to us from time to time for a set of specifications for house wiring that might be used as a model by contractors or house owners when drawing up contracts of this character. In answer to this demand we reprint on other pages of this issue a form which has been drawn up by the Minneapolis Electrical Board in order to have a uniform specification for general use in that city. This involves a schedule of outlets and switches, and a set of general specifications covering the essential points of the contract. Among these are the requirements that the installation shall meet with the approval of the city inspector and the owner, and shall conform to the regulations of the central station.

These forms are supplied by the central station (The Minneapolis General Electric Company) and by contractors to house owners who intend to have wiring done, and it is suggested that bids be obtained from more than one contractor Since such bids are made upon identical forms, it is felt that underbidding on a basis of supplying an inferior installation will be eliminated.

Electric Club-Jovian League Picnic Arrangements.

At the meeting of the Electric Club-Jovian League of Chicago, held on June 17, H. A. Mott, of the Chicago Telephone Company, was appointed chairman of the Picnic Committee and empowered to appoint his own committee. Mr. Mott was chairman of the Picnic Committee of last year and the success of that event led to his being again selected for the post. It is expected that Ravinia Park will again be selected as the site for the picnic, which will be held early in August.

A committee was also appointed to arrange for the annual convention of the Jovian Order which will be held in Chicago in October. This committee is composed of Victor H. Tousley, chairman; Morgan Ellis, vice-chairman; Walter Bischoff, Perry Boole, G. W. Cummings, A. A. Gray, C. R. Kreider, Thomas G. Grier, Mike S. Hart, H. E Niesz and J. G. Wray.

The meeting on June 17 was given over to entertainment, in charge of W. G. E. Peirce, chairman of the Entertainment Committee.

Meeting of Minnesota Engineers.

A group of over fifty members of the Minnesota Sections of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers held a two-day meeting and outing at Duluth, June 11 and 12, with so much satisfaction to themselves that a plan is under way to have all the engineers of the state meet together annually in Duluth.

St. Paul and Minneapolis engineers went to Duluth on a special train on the afternoon of June 11. A business meeting was held in the evening, at which W. N. Ryerson, superintendent of the Great Northern Power Company, Duluth, read a paper describing the system and development of his company. Nearly all the coal docks, he said, are supplied by the Great Northern Company. One interesting factor mentioned by Mr. Ryerson is that the Great Northern Company has one customer, a manufacturing plant, which uses one-half of its total output of electrical energy. This company is able to use the current at such times as to be an off-peak load. The daily load-factor for the plant, Mr. Ryerson said, averages over 90 per cent. The company has another power site on the St. Louis River which it proposes to develop soon.

John Hearding, of the Oliver Mining Company, gave a talk on mining operations, illustrated by motion pictures.

The following day, June 12, was devoted to a tour of the ore docks and the new steel plant. In this plant there is already installed a 6,000-horsepower, 6,600-volt motor and a 3,500-kilowatt generator operated by a gas engine. The entire afternoon was spent by the engineers in the inspection of this plant and its machinery.

A boat trip was made about the Duluth harbor and up the St. Louis River to Spirit Lake. The meeting closed with a dinner at the Commercial Club in the evening, at which W. T. Hugo, a Duluth engineer; Dean F. C. Shenehon, of the Engineering College of the University of Minnesota; Fred G. Dustin, of Minneapolis; C. W. Tubby and Mrs. Tubby, of St. Paul, gave short informal talks.

Application of Diversity-Factor.

On the evening of June 21 a joint meeting was held in Chicago by the Chicago Section, American Institute of Electrical Engineers, and the Electrical Section, Western Society of Engineers. The results of the postcard election of officers of the former organization for the fiscal year, 1915-1916, was announced, as follows: Chairman, William J. Norton; secretary, Taliaferro Milton; member of Executive Committee for three years, E. W. Allen.

H. B. Gear, engineer of distribution of the Commonwealth Edison Company, gave an abstract of his paper on "The Application of the Diversity-Factor," which he had presented before the National Electric Association's San Francisco convention on June 8. This paper reviewed the earlier studies of diversity in central-station service made by Messrs. Lloyd and Gear, discussed the nature of diversity and pointed out the distinction between daily diversity and seasonal and yearly diversity, also between group diversity and individual diversity. Mr. Gear showed that in a large central-station system supplying varied classes of customers there is considerable difference in time between the maximum loads of the different classes or groups of customers, which makes the maximum load on the supply system less than the sum of the various maxima of the different groups. This ratio is defined as the diversity-factor. Mr. Gear emphasized that it should really be designated as the group diversity-factor. He showed the importance of considering the individual diversity-factor of large individual customers of a group, and explained in what way this affects the investment in the plant and the rate which should be made for the service. The group load-factor is the product of the average individual load-factor by the group diversity-factor.

The subject was briefly discussed by P. Junkersfeld, J. R. Cravath, T. Milton, W. J. Norton, W. B. Jackson and Mr. Gear.

Chicago Section, Electric Vehicle Association.

A. J. Marshall, executive secretary of the Electric Vehicle Association of America, was the guest of the Chicago Section at its meeting on June 22 and outlined the activities of the parent organization. Through the committees of the Association the electric vehicle is being given great impetus and this should be capitalized by the various sections. Mr. Marshall called attention to the articles which are being sent to newspapers and magazines throughout the country and the value of this publicity to the industry. Mention was also made of the co-operative advertising carried on by sections in some of the eastern cities. Efforts are being made to have the electric passenger car used in motion-picture plays in place of the gasoline car.

John F. Gilchrist, president of the Association, spoke briefly, preceding Mr. Marshall. He stated that the annual convention to be held next October will in all probability be held in Cleveland.

Jobbers Meet at Detroit.

The quarterly meeting of the Electrical Supply Jobbers' Association was held at Hotel Statler, Detroit, Mich., June 15, 16 and 17. This important gathering of electrical jobbers attracted a large representation of manufacturers, who found opportunity to exchange views in regard to trade conditions and the unusual and altogether unprecedented rise in the metal market.

Two interesting addresses were delivered in open meeting on the morning of June 17. J. H. Trumbull, of the Trumbull Electric Manufacturing Company, spoke on "The Weak Points of the Jobber," and J. Warren Ripple, of the George Cutter Company, on "The Electrical Jobber as an Exploiting and Selling Medium from the Standpoint of the Manufacturer."

A visit to the Ford plant and a delightful trip up the Detroit River to Lake St. Clair were made.

Fewer Accidents With Near-Side Stops.

Figures prepared by the Accident Bureau of the New York Public Service Commission for the First District for the first four months of 1915 as compared with the same four months of 1914, before the near-side stop was practiced on surface car lines, show that there has been a decrease in the number of persons killed and a larger proportionate decrease in the total number of accidents. The total number of accidents of all kinds for the four months decreased from 10,650 in 1914 to 8,597 in 1915, and the fatal accidents from 37 to 29.

Electrical Construction Details of Butler Brothers Building.

By Norman G. Meade.

The firm of Butler Brothers put up new buildings a few years ago, and this article describes the electrical equipment which was installed. This covers miscellaneous motor drive and lighting, and some electric heating appliances. Fire-alarm and signaling apparatus is also included. Central-station current is used.

Butler Brothers, Chicago, have the distinction of being the only mail-order concern in the country that sells to merchants only. Their establishment consists of the main building containing the general and executive offices, the stockrooms and sample rooms, and two large warehouses designated as A and B. The main building fronts on Randolph Street and extends north along Canal Street to Lake Street; it is 15 stories high 382 feet long and 151 feet wide, and is connected to warehouse A, which occupies the space between the main building and the Chicago River and the block between Randolph Street and Lake Street. Each floor of the main building is divided into two general sections, one with a floor area of 32,450 square feet and the other with a floor area of 25,500 square feet.

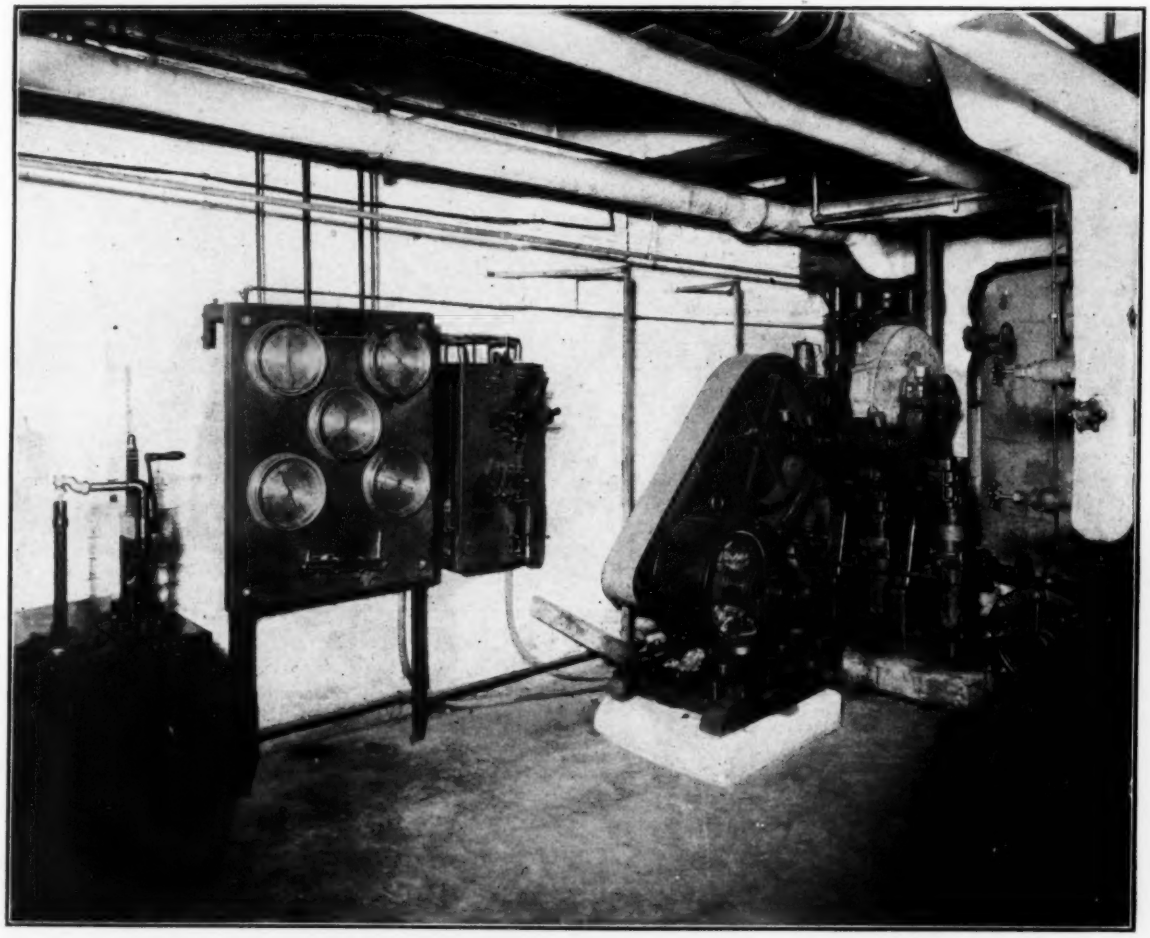


Fig. 1.—Electrically Driven Triplex Water Pump with Automatic Control.

"Do It Electrically" aptly applies to this firm, as every part of the business not requiring manual labor uses electricity as a motive power. Even the extensive roof garden provided for the benefit of the employees has an electric piano and electric fans. Throughout the offices there are numerous minor motor applications, such as addressing machines, mailing machines, accounting machines, etc. The merchandise handled comprises everything in household equipment and general mercantile specialties.

General Features of Equipment.

The general electrical equipment comprises about 75 electric motors, 10,000 incandescent lamps ranging from 10 to 250 watts and miscellaneous applications such as electric glue pots, electric fans, etc. The connected load is in the neighborhood of 400 kilowatts on Commonwealth Edison Company's service and the average cost for current per kilowatt-hour is 2.25 cents. All of the office and a considerable part of the display department lighting is indirect, X-ray fixtures being used for this part of the illumination. The principal motor applications are: woodworking machinery, linotype machines, printing presses, exhaust fans, air washers, pumps, and air compressors.

Included in the elevator equipment

are 23 freight elevators and 7 passenger elevators, all of the Otis electric traction type with overhead drive, with the exception of one hydraulic elevator. The electrical equipment was installed by the F. E. Newbury Electric Company, of Chicago, and the entire electrical and mechanical equipment is under the charge of the chief engineer.

This description will be confined principally to the main building, which is of recent construction, consisting of reinforced concrete with brick outside walls. The main switchboard, shown in Figs. 2 and 3, is located in a room in the basement and the service entrance is in its rear, coming in from service mains on two different streets. The service cables in conduits come through the basement wall and enter a large steel cabinet. From this cabinet ten 1,500,000-circular-mil cables in three-inch conduits lead down through the floor and up back of the switchboard. Details of the arrangement are illustrated in Fig. 6. There are three positive, three negative and two neutral feeders, with two extra feeders comprising the three-wire 110-220-volt direct-current system.

All fuses and the maximum-demand meters are located on the rear of the board, which consists of six marble panels with the necessary equipment of instruments. The panels include two lighting-feeders, one power-feeder, one positive, one negative and one neutral panels. Each lighting-feeder panel contains eight triple-pole single-throw switches caring for 16 lighting feeders. The positive panel is equipped with four single-pole positive switches and one large Thomson watt-hour meter. The negative panel has a similar equipment; the neutral panel is provided with two single-pole neutral switches and a Thomson watt-hour meter similar to those on the positive and negative panels, and two smaller watt-hour meters for the lighting circuits below the second floor. Two of the large watt-hour meters are for the lighting load and one for the power load. The power-feeder panel has 18 double-pole single-throw feeder switches.

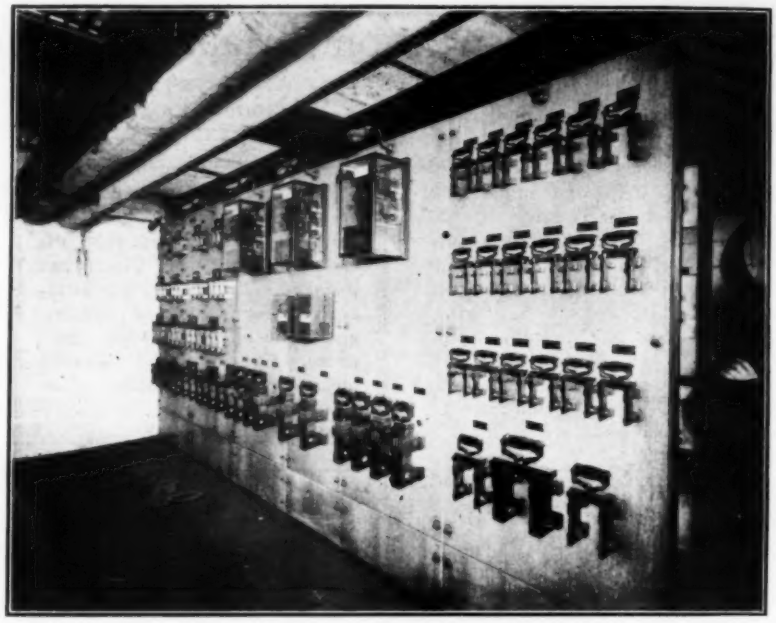


Fig. 2.—Front View of Main Switchboard.

Heating and Ventilation.

Heating and ventilation, although not strictly an electrical proposition, has a direct bearing on the nature of the electrical equipment, especially where central-station service is used. Furthermore, there are numerous applications for electric motors in connection with heating and ventilating apparatus, as will be seen from the following description. Where there is no power plant, live steam has to be utilized for heating and in many cases this equipment does not vary greatly in design from a boiler plant used for power purposes.

The boiler equipment consists of two 300-horsepower and one 100-horsepower boilers located in the sub-basement of the main building and three 100-horsepower boilers in annex A. The normal working pressure of the boilers is 75 pounds, which is reduced to the circulating pressure by reducing valves. There is a total of 140,000 square feet of radiating surface in the heating system, which is equipped with Webster and Wilworth valves.

Next in importance to an effective and efficient heating system is a system of ventilation which, when properly designed, has two functions, the removal of vitiated air and its replacement with a clean supply of fresh air. For removing the foul air in the Butler Building there are two exhaust fans with ducts reaching the lower floors. They are American propellers with a capacity of 44,964 cubic feet of air per minute, each direct-connected to a 15-horsepower motor operating at 410 revolutions per minute. The motors are attached to the propeller frames and the combined units secured to panels in the outside wall

Fig. 3.—Rear View of Main Switchboard.

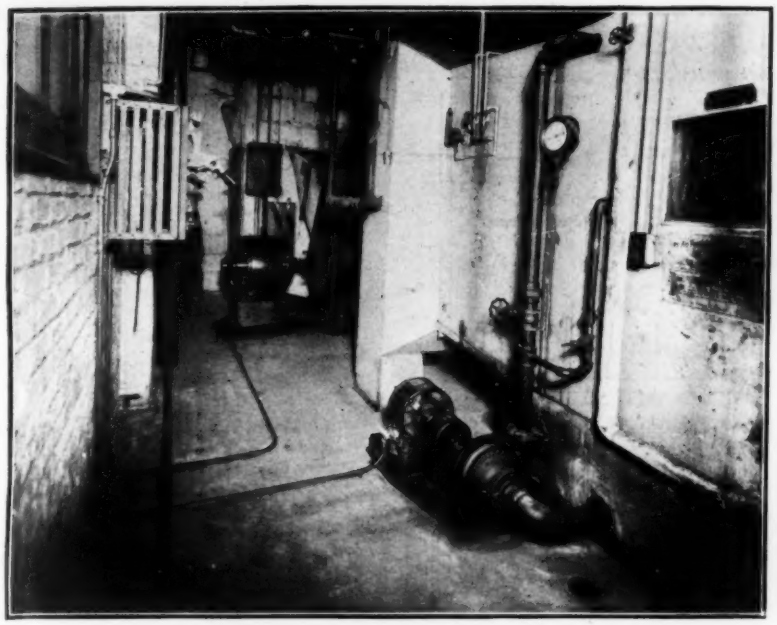


Fig. 4.—Air Washer and Motor-Driven Blower.

having a circular opening corresponding to the fan diameter. This arrangement is shown in Fig. 7. The air duct covers the outfit, but the latter is made accessible by a sheet-iron door in the side of the duct. The motor switch and the starting rheostat are mounted on the wall outside of the duct, the former in a steel cabinet. All connections to the motor and the feeders leading to the starting devices are carried in conduit.

For supplying fresh air to the building there are five Acme air purifiers, coolers and humidifiers, and five Sirocco blowers for forcing the air through ducts to outlets under the radiators of the various departments. The function of the former appliance, shown in Fig. 4, is to wash the air by passing it through a curtain of water which at the same time adds humidity and then, in cold weather, pass the air over steam coils into a room where the Sirocco blower is located, the latter forcing the air through the ducts. In hot weather the action of the air passing through the curtain of water lowers the temperature. The air intake is through an adjustable iron shutter in an outside wall leading into an inclosed sheet-metal chamber where a pipe drilled with a great number of fine holes on its under side, extends across the chamber so that the spray emitted forms a water curtain. The water is caught in a large drip pan and is kept in continuous circulation by a centrifugal pump driven by a direct-coupled two-horsepower motor operating at 1,150 revolutions per minute. The coils for heating the air, occupy the end of the inclosed chamber farthest from the air inlet; this end of the chamber is open and the blower is placed in close proximity to this opening. Details of this apparatus are shown in plan in Fig. 8. The Sirocco blower has a capacity of 13,200 cubic feet of free air per minute and is direct-coupled to a 5.75-horsepower motor operating at 400 revolutions per minute. The starting panels for both motors are similar in construction. Both are self-contained with resistances at the back of the panel and circuit-breaker and starting rheostat on the front. A steel cabinet is mounted on the side wall near the starting panels which contains the two double-pole single-throw motor-starting switches. A conduit leads from each starting panel down the side wall and through the floor to the respective motor.

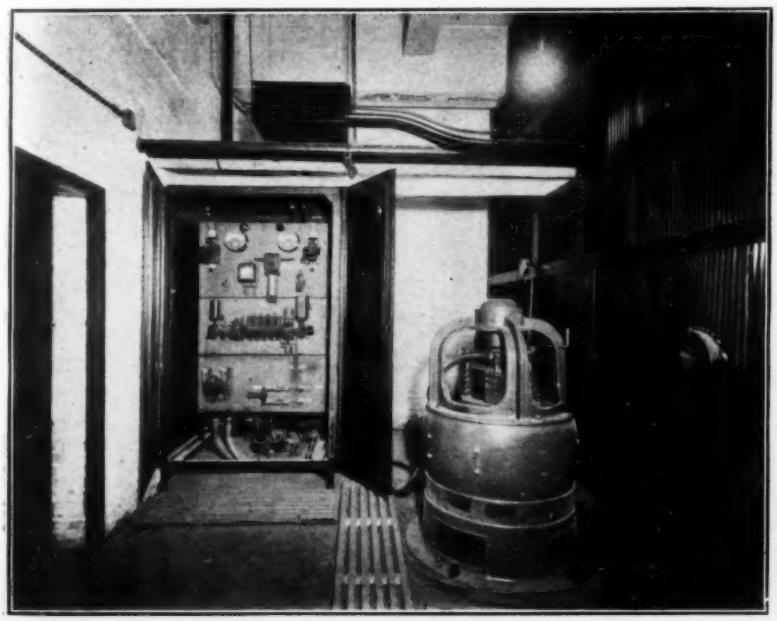


Fig. 5.—Fire Pump and Controller.

Fire Protection and Signaling Systems.

Under this head properly come fire pumps, the sprinkler system, fire-alarm system, burglar alarms and employees calls, all of which are dependent upon electrical operation. The fire pump equipment, illustrated in Fig. 5, consists of a vertical-type motor rated at 150 horsepower, and operating at 150 revolutions per minute, direct-coupled to a centrifugal pump located in a pit below the floor level. The pump has a capacity of 10,000 gallons per minute. The motor is controlled by a Sundh automatic starting panel located in a steel cabinet with two swing doors on the front. It is equipped with main switch, automatic motor-starting rheostat that can be manually operated if desired, and a circuit-breaker. The pump is ordinarily controlled by the water pressure, a minimum of 110 pounds starting the motor and a maximum of 120 pounds stopping it through the agency of the automatic starting switch. There are two service entrances connecting with the fire-pump starting panel to insure continuity of current supply in any emergency. The steel cabinet containing the starting panel is raised from the floor on iron supports and the connections with the motor are inclosed in conduits.

The fire-alarm system was installed by the Gamewell Fire Alarm Tele-

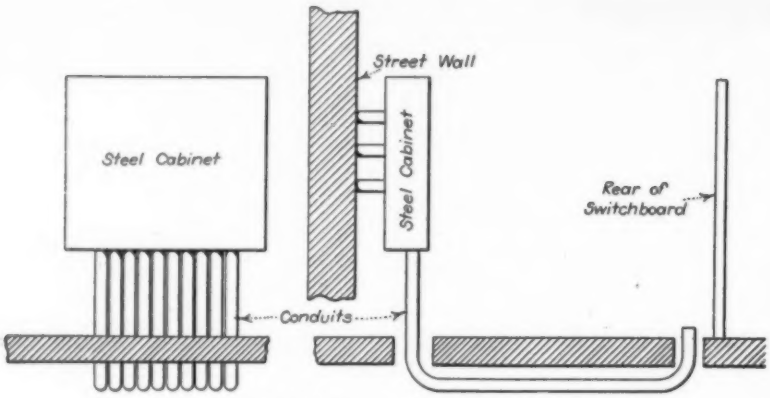


Fig. 6.—Details of Service Entrance.

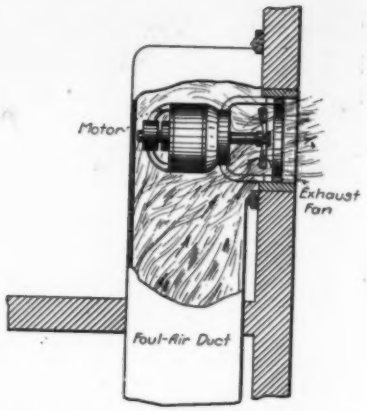


Fig. 7.—Installation Details of Exhaust Fan.

graph Company and consists of 34 type K fire-alarm boxes, a punching register, relays and a switchboard. The boxes have a glass front, which is broken in case of fire, when a hook is pulled down that starts the mechanism. This operates a notched wheel that automatically opens the main circuit by separating two contact springs normally in contact. The wheel is provided with notches corresponding to the box number, for example, for box 23 there are two notches, a space and three notches in the wheel. As the wheel revolves one of the contact springs drops into the notches separating it from the second spring instantaneously and opening the circuit through a relay. The relay armature when released closes a local circuit through the punching register and the latter punches the box number in a paper tape. The relays are supported on a wall panel near the system switchboard. A schematic connection diagram is shown in Fig. 11.

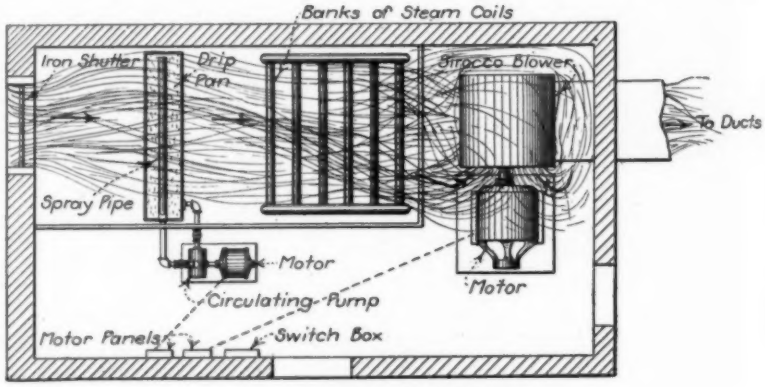


Fig. 8.—Details of Air Washer.

For supplying current to the fire-alarm system there is a Holtzer-Cabot motor-generator set consisting of a one-third-horsepower 115-volt motor, direct-coupled to a direct-current 15-volt generator. This set also furnishes current for the signaling systems. It is supplemented by a storage battery for the fire-alarm system. The battery consists of two sets of 22 cells each, one for use while the second set is charging. The motor-

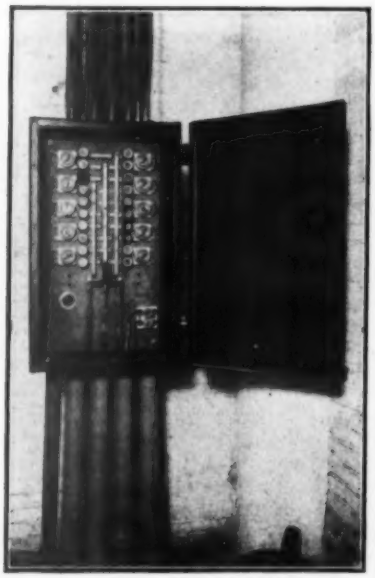


Fig. 9.—Typical Junction Box.

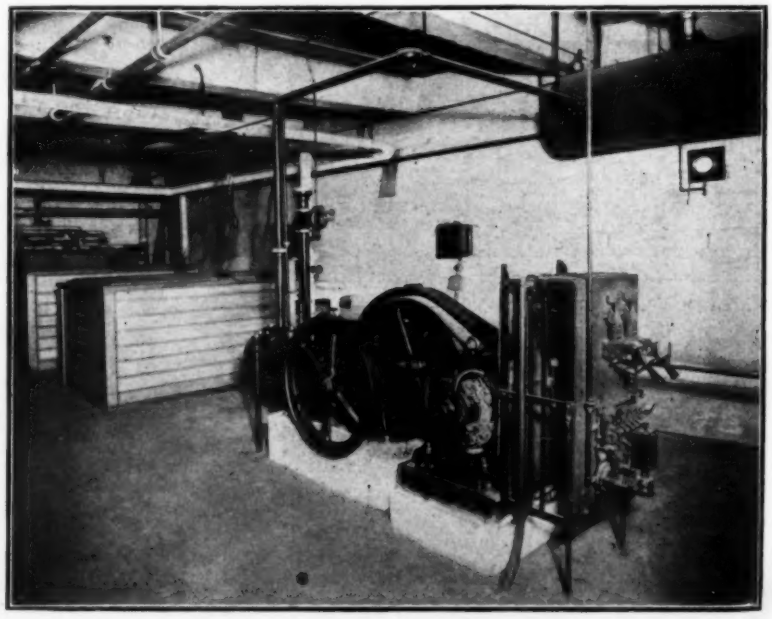


Fig. 10.—Motor-Driven Air Compressor.

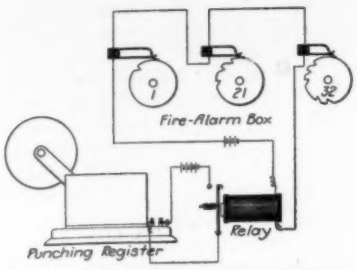


Fig. 11.—Schematic Connection Diagram of Fire-Alarm System.

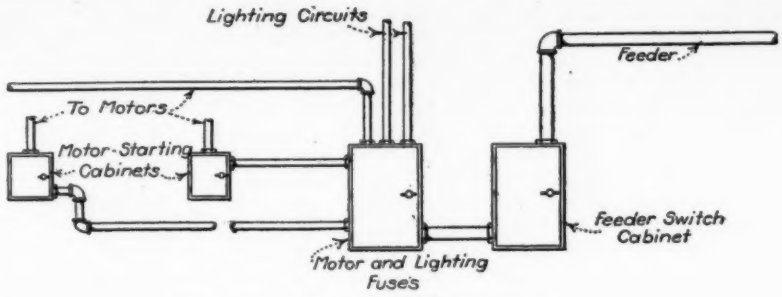


Fig. 12.—Conduit Runs in Box Department.

generator is mounted on the top of the right-hand side of the battery rack and the switchboard, shown in Fig. 14, is located over the left-hand end. The latter consists of two panels, one for the circuits of the fire-alarm system and a charging panel for the batteries. On the former there are a voltmeter, ammeter, voltmeter switch, ammeter switch, test key and rheostat. The charging panel

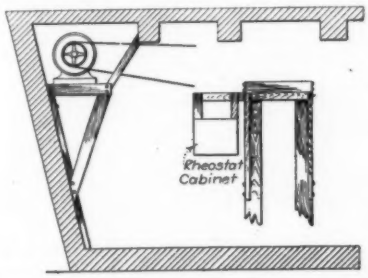


Fig. 13.—Method of Mounting Motors.

contains a charging rheostat, ammeter, double-pole double-throw battery switch, and a double-pole single-throw main switch.

The watchman's system is of Western Union style and there are burglar alarms placed on the stairways and the fire escapes. For calling heads of departments, the Tell-Call system has been installed, which consists of single-stroke bells located throughout the building and controlled from a central point. A given number of strokes of the bell summons a certain employee to the nearest telephone, where he calls the switchboard operator to learn where he is wanted.

In connection with the sprinkler system there is a motor-driven air compressor, shown in Fig. 10, for supplying additional pressure to the sprinkler mains. The outfit consists of a 7.5-horsepower motor operating at 1,150 revolutions per minute mounted on the same base with a Blaisdell 8-by-8-inch single-cylinder air compressor running at 200 revolutions per minute, using silent chain drive. The control panel is self-contained with the resistance on the rear of the panel and is supported on angle-iron framework. On the front of the panel there are mounted a compressed-air-actuated automatic switch, an automatic starting rheostat and a circuit-breaker. The compressed-air switch is connected by a pipe line to the compressor tank on the wall and so arranged that the motor and compressor are automatically started and stopped by a predetermined maximum and minimum air pressure.

Supplementing the steam pumps for supplying feed water and feeding the storage tanks there is a Dean 6-by-8-inch triplex pump, chain-driven from a 15-horsepower motor. This is shown in Fig. 1.

Printing Department.

For the publication of catalogs and other classes of work, a complete elec-

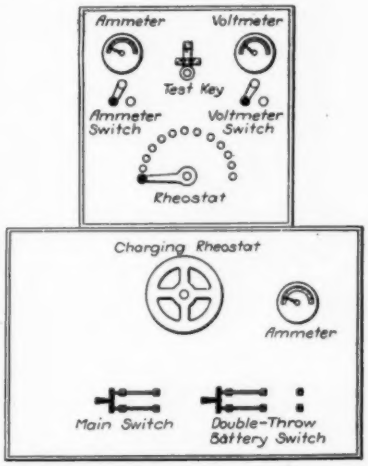


Fig. 14.—Details of Fire-Alarm Switchboard.

trically operated printing department, shown in Fig. 15, is in operation. In the composing room, special attention has been given to the lighting and the direct illumination system is used, with lamps placed five feet from cen-

Fig. 15.—General View of Printing Department.

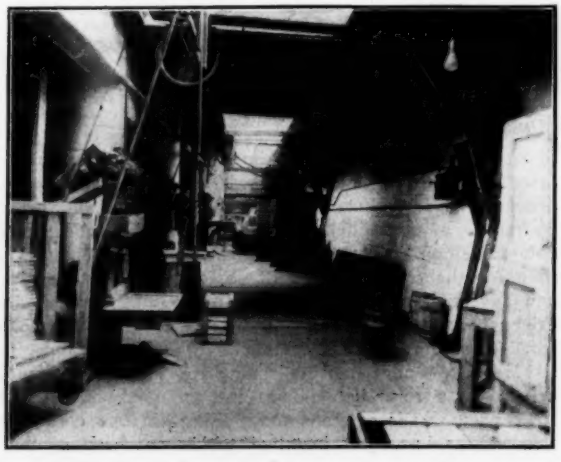


Fig. 16.—General View of Box-Making Department.

ter to center. The machine equipment in the composing department consists of three linotype machines, each driven by a one-horsepower motor. In the department known as the molding room, where matrices of type forms are made, there is a matrix molding machine direct-driven by a three-horsepower motor. In this room there is also a two-horsepower motor driving an air compressor used to furnish air for cleaning purposes.

In the press room there are three Miehle power presses, three Gordon job presses and a multicolor machine. The Miehle presses are the proper size for catalog and similar work; two are driven by two-horsepower and one by a three-horsepower motor. Short belts with idlers constitute the drive. The three Gordon presses are driven from 0.75-horsepower motors by means of short belts. The multicolor machine, as its name implies, is used for the color printing of posters and advertising material and is belt-driven by a one-sixth-horsepower motor. The equipment is completed by a Holyoke paper-cutting machine driven by a three-horsepower motor.

To prepare the catalogs for mailing a conveyor has been installed which handles 1,600 catalogs an hour and is attended by nine girls. It is an endless belt arrangement driven by a 1.75-horsepower motor. As the catalogs come in on trucks from the printing department they are fed on the belt and one girl at a time has specific duties to perform; one will insert extra circulars, another place the catalogs in envelopes, etc.

Box-Making Department.

Facilities for making boxes and crates rapidly and cheaply is a function of many classes of business and the Butler plant is no exception to the rule. In this department, illustrated in Fig. 16, group drive is used, the machines being grouped as follows: three cross-cut saws driven by a 10-horsepower motor; second group of three cross-cut saws driven by a 10-horsepower motor; two cross-cut saws, two rip saws, one box-nailing machine and one emery grinder driven by a ten-horsepower motor; two box-nailing machines operated by a five-horsepower motor. The box-nailing machines are designed to drive a large number of nails with one operation. For example, a lid is laid on a box and it is placed in the machine and with one stroke the nails are driven in one end or side. By changing the position of the box the four sides of the cover can be nailed in four strokes of the machine.

Motors in this department are mounted on brackets near the ceiling. The brackets, one of which is shown in Fig. 13, are wooden and supported by two planks bolted to the side wall, which slopes inward. The outer end of the bracket is braced by angle braces to the planks and also by wood braces bearing against one of the reinforced-concrete beams.

As an example of the electrical construction, three motors in the box department are supplied with one feeder in conduit which leads to a feeder switch in a steel cabinet located near the motor.

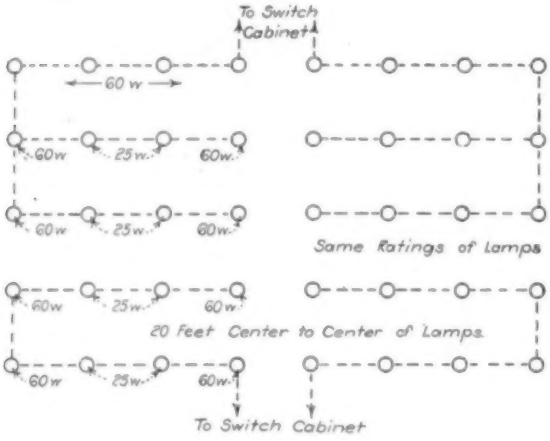


Fig. 17.—Typical Arrangement of Circuits.

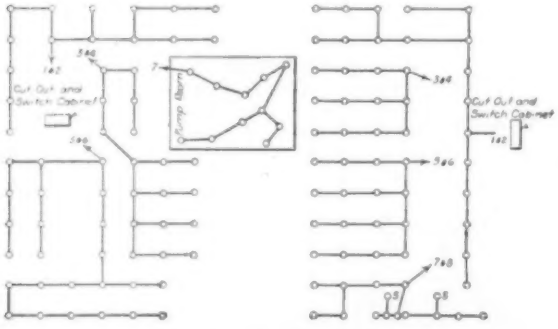


Fig. 19.—Layout of Lighting in Sub-basement.

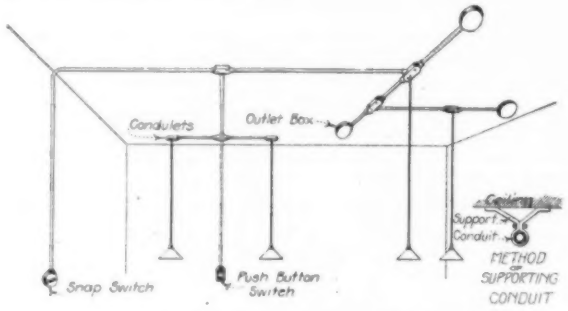


Fig. 18.—An Arrangement of Exposed Conduit.

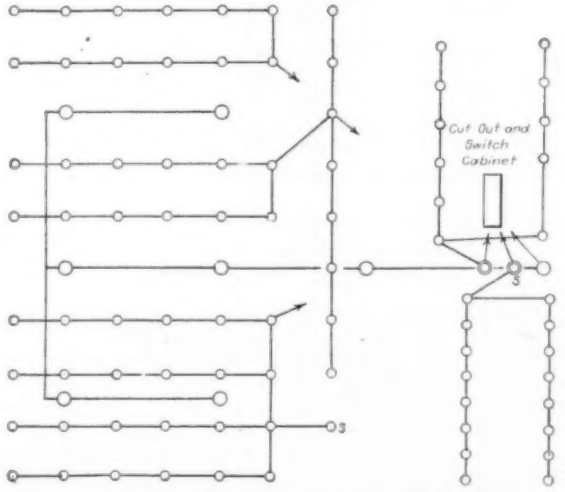


Fig. 20.—Typical Arrangement of Circuits on Certain Floors.

This cabinet is connected with conduit to a fuse cabinet adjacent. This contains the motor fuses as well as lighting-circuit fuses. From the fuse cabinets conduits lead to three steel cabinets containing the motor switches and starting rheostats for three motors. This construction is shown in Fig. 12.

Filter System.

Drinking water supplied to the sanitary drinking fountains located throughout the building is supplied through a Bowdin single-valve filter in connection with two cooling tanks containing pipe coils and ice. The water is circulated by a centrifugal pump driven by a one-horsepower

motor. The controlling apparatus is mounted on the wall nearby; the starting rheostat is at the top with a snap switch and the fuse bow below; both of the latter are in steel boxes. The feeder comes up through the floor connecting with the starting apparatus and a branch conduit is lead to

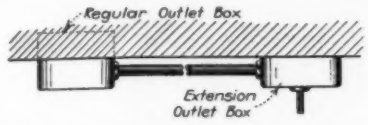


Fig. 21.—Method of Shifting Position of Outlet.

the motor near the floor. Fig. 23 shows the arrangement of the filter outfit and motor wiring.

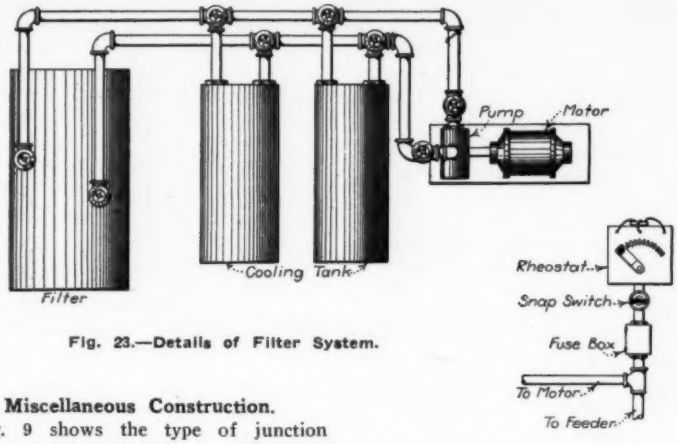


Fig. 23.—Details of Filter System.

Miscellaneous Construction.

Fig. 9 shows the type of junction box used in the building. Two typical examples of the conduit layout for lighting may be illustrated by a section of two departments, as shown in Figs. 17 and 22. In the first the lamps of 25-watt and 60-watt ratings are arranged in groups of twelve and eight respectively and in the second in groups of twelve and fifteen with 25-watt units. In both cases the lamps are spaced 20 feet center to center.

In the basement departments open conduit work is largely used, and the

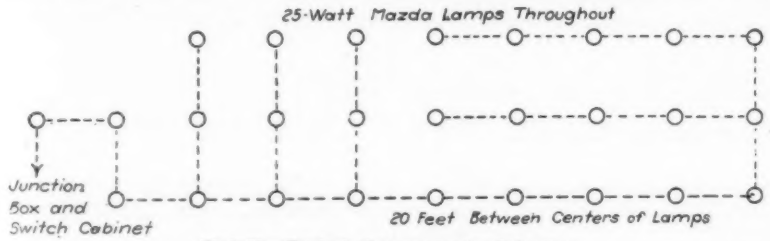


Fig. 22.—Typical Arrangement of Lamps.

MOTOR INSTALLATION—BUTLER BROTHERS' NEW BUILDING.

230-Volt Direct-Current Motors.—Exclusive of Elevators.

No.	Horse-power.	Kind of Drive.	Speed in Revolutions per Minute.	Application.
1	7.5	Individual chain	1,150	Blaisdell 8-by-8-inch single-cylinder air compressor for sprinkler system.
1	1	Direct-coupled	1,750	Centrifugal circulating pump for Bowdin single-valve filter and cooling tanks—drinking-water system.
1	15	Individual chain	.....	Deane 6-by-8-inch triplex pump operating in connection with steam pumps.
1	1/3	Direct-coupled note (115 volts)	1,750	Generator (15 volts) for fire-alarm and signaling system.
1	150	Vertical direct-coupled	150—270	10,000-gallon centrifugal fire pump.
2	15	Direct-coupled	410	American propeller exhaust fan; 44,946 cubic feet of air per minute.
5	2	Direct-coupled	1,150	Centrifugal circulating pump for Acme purifier, cooler and humidifier.
3	5.75	Direct-coupled	400	Sirocco blower for ventilating system; 13,200 cubic feet of air per minute.
1	1.75	Belt	Slow speed	Barrel conveyor. Carries catalogs past girls who place in envelopes, stamp, etc.
3	1	Belt	.....	Linotype machines.
1	2	Direct-connected	.....	Air compressor for cleaning out type racks, presses, etc.
1	3	Direct-connected	.....	Matrix molding machine.
2	2	Belt	.....	Miehle power press for catalog and similar work.
1	3	Belt	.....	Same as last.
3	0.75	Belt	.....	Gordon job presses.
1	1/6	Belt	.....	Multicolor machine.
1	3	Belt	.....	Holyoke paper cutter.
2	10	Group	.....	Three crosscut saws.
1	10	Group	.....	One box-nailing machine, two crosscut saws, two rip saws, one emery grinder.
1	5	Group	.....	Two box-nailing machines.

arrangement for lighting one room will serve as an example. Here are located four drops lights all controlled from a snap switch on the side wall. Two of the lamps are for illuminating framed drawings and can be shut off or turned on by a push-button switch secondary to the snap switch. Fig. 18 shows the arrangement.

In the layout of the lighting the principal object sought was to secure a maximum efficiency with a minimum expenditure for current. In some departments the ultimate location of all the lights was uncertain, so that the scheme for changing the position of individual lamps from the regular outlets, shown in Fig. 21, was employed. An outlet box is attached to the under surface of the ceiling over a regulation outlet box and a length of conduit run to a second outlet box for the drop light.

Fig. 19 shows the lighting layout for a section of the sub-basement where 25-watt units are used, with an average spacing, center to center, of 22 feet, arranged in groups of from 12 to 24 lamps on two circuits each, with an average of eight circuits to one cutout cabinet. Nos. 12 and 14 wire are used for the circuits, drawn into three-quarter-inch conduit. The basement lights are of 25, 40 and 60-watt ratings, spaced an average distance of 22 feet from center to center. As in the sub-basement, three-quarter-inch conduit is used and the same general arrangement of grouping is employed.

What is a typical arrangement of lighting and circuits for the third, fifth, seventh and eighth floors is shown in Fig. 20. The lights in the bays are 25-watt, and those in the aisles are 60-watt, and are controlled separately from the bay lights. On the second or office floor aside from the switch cabinets, individual switches on the pillars serve to control those lamps located in range of the natural light from the windows. The lamps in the individual offices are also controlled by individual switches.

The schedule of motors installed is given in the table.

Commercial Practice
Management, Rates, New Business

Converting the Chronic Kicker.

It is inevitable in the central-station business that mistakes will occur in serving so many customers and complaints will have to be adjusted, but in spite of the most stringent policies of service first, public be pleased, square deal to all, etc., it is impossible to eliminate the chronic kicker. How to deal with this class of customers is a problem that has been given serious consideration and many companies are experiencing gratifying results because of adopting definite policies in this connection. Among such companies is the Elmira (N. Y.) Water, Light and Railroad Company which has greatly minimized the number of complaints by the adoption of progressive methods.

In the *Bulletin* of the United Gas & Electric Engineering Corporation, F. E. Tripp, advertising manager of the Elmira company, writes regarding the company's complaint system as follows:

The Elmira Water, Light & Railroad Company doesn't furnish an audience for the oratory of the complaining patron any more. It did for a long time. It was bad business. The only audience the complainant now has is a gentlemanly, even-tempered, easy-going go-between, who likes his job—and is welcome to it.

The kicker has been given a new stage setting, too. He doesn't stand in line any more under an inviting sign over a drafty little window, which was advertised as the "Complaint Department." He doesn't put wrathy ideas and anarchistic sentiments into the minds of a dozen more who are anxious for a chance at the terribly bored individual behind the counter. He doesn't threaten vengeance on the company all the way from the Public Service Commission down to setting his dog on the meter reader. All the fun of preparing a beautiful speech for the amusement of brother kickers is past and gone. He has only his recollection that "Those were the good old days."

Now when he calls, or when she calls, if it happens to be a "she," and very often she is, she is ushered into the tidiest little room in the whole building. She gets a minute to comprehend her surroundings. The oriental rugs, the unusual wicker furniture and wicker lamp and the restful effect of the bright chintz are suggestive of satisfaction with life. She has been dropped into surroundings which smother her ire and she gets a greeting from the professional adjuster which takes her breath away.

Of course she is right. The bill seems preposterous. There must be some mistake. She must understand that in handling the thousands of patrons of the company the human frailty of erring must creep in, and it is not impossible that this time she has been the victim. When she has come to understand that the folks who are running the corporation are human beings the same as herself, she is in a frame of mind to receive her answer.

She gets a square deal. They all did before, but they didn't believe it. The little room and the everlasting study of human nature gives the complaint man his start in life. He plays every game on the home grounds and he meets one opponent at a time. It's the most satisfactory thing in direct connection with the public of the many that General Manager Hill has introduced.

The complaint department has a record book of all complaints, the date of their receipt and the manner and date of settlement. The general manager receives this book twice a week and reviews it. Every complaint is supposed to be settled in 24 hours or the reasons given. In every instance the general manager writes a letter to the customer, expressing the hope that his little matter has been satisfactorily adjusted. If it hasn't, he will thus learn. By this proper care of complaints they have been materially reduced. A card file of chronic kickers has been prepared. Instead of treating them as such, a study of why they are chronics is being made and every legitimate effort is made to set them thinking differently.

Comparative Cost of Candle Light and Electric Light.

Engineers of the New York Edison Company have recently concluded a series of tests showing the comparative costs between candle light and electric light. In spite of the fact that candles may be purchased as cheaply as a cent each, this is the most expensive illuminant available.

One cent will furnish 2.68 candle-power-hours of candle light. For the

same money and using the drawn-wire Mazda lamps 120 candlepower-hours may be obtained, while the recently perfected gas-filled lamp will give 192.3 candlepower-hours.

The figures are the result of tests with six candles of the ordinary commercial types. Four were tallow and two were sperm. They varied from 4.875 inches to 5.75 inches in length and were from 0.75 to 1.125 inches thick. Three cost one cent each, two cost two cents each and one cost 3.5 cents.

One of the one-cent tallow candles burned 2 hours and 22 minutes, another burned 2 hours, 24 minutes, while the one-cent sperm candle lasted 3 hours, 47 minutes. The two-cent tallow candles lasted 4 hours, 24 minutes and 5 hours, 31 minutes, respectively. The 3.5-cent sperm candle lasted almost 9 hours.

The cost of electricity was computed at 8 cents per kilowatt-hour, the prevailing rate in New York City.

Possibilities of Electric Fan in Window Dressing.

A Boston suburban druggist is operating an electric fan in a novel way, producing an attractive advertising feature. In an inclosure formed by a screen erected about 18 inches behind a show window 20 or 25 toy balloons are caged, with the fan at one side of the window ledge directing its air currents parallel with the window, and slightly below the horizontal. The "breeze" serves to cause the balloons to rise and fall in a continuous, dancing procession, creating interest and wonder on the part of the spectators outside to whom the fan is hidden. A cord network in front of the fan provides against harmful contact from the balloons.

Cheap Energy for Cooking in Minnesota.

An offer was made June 18 by the Otter Tail Power Company, which supplies the city light plant at Fergus Falls, Minn., with the electrical current, to reduce the cost of current consumed in cooking to 1.5 cents per kilowatt-hour for the first 100 kilowatt-hours, 1.25 cents for the next 100, and 1 cent for all above 200 kilowatt-hours, provided the city would reduce the price to consumers to 2.5, 2 and 1 cents per kilowatt-hour, respectively. The present cooking rate is 3 cents per kilowatt-hour.

The stockholders of the Cambridge (Mass.) Electric Light Company have voted to increase the capital stock from $900,000 to $1,100,000 by issuing 1,000 new shares at $200 each.

Air-Lift Pumps as a Central-Station Load.

Pumping by compressed air with the air-lift pump is a method that has been in use to some extent for a number of years, but the subject is one on which there is comparatively little information published. In general, such a pump consists of a pipe submerged in a well or body of water with a smaller pipe delivering compressed air into the bottom end. The column in the pipe is a mixture of liquid, and air in the form of various sized bubbles, which makes the column lighter than the body of liquid, consequently the liquid in the pipe will rise higher than the surrounding surface and a continuous flow results.

There are no moving parts in an air-lift pump which makes it especially adapted to handling dirty water, sewage, oil, and acid and alkali solutions. The air is furnished by an air compressor which preferably should be motor driven. One air compressor may be arranged to furnish air to several wells and be automatically controlled. There are two general methods of automatic control, electrical and electro-mechanical. The former arrangement consists of a pressure gauge with make-and-break contacts which close circuits through an electrically-operated main switch, that in turn closes the circuit through the motor and an automatic starting rheostat. When a predetermined maximum or minimum pressure has been reached the motor will be stopped or started as the case may require.

The mechanical method of control consists of a compressed-air operated main switch which is connected to the air receiver by a small pipe line. The switch is closed and the motor started when a predetermined minimum pressure has been reached, and is opened and the motor stopped when the maximum pressure is reached. The automatic main switch,

Ingersoll-Sergeant Standard Air Compressors.

Class and Type	Diameter of Cylinder Inches		Stroke In.	R. P. M.	Capacity Cu. Ft. free air, per Minute	Working Air Pressure	HORSE-POWER
	High	Low					
B Straight Line, Belt Driven	10¼		12	160	177	50–100	23–35
	12¼		14	155	285	50–100	37–57
	14¼		16	120	381	50–100	50–76
	16¼		18	120	498	50–100	65–100
D-1 Duplex and Half Duplex Belt Driven	10¼		12	160	325	60–100	50–67
	12¼		14	155	568	60–100	81–108
	14¼		18	120	763	65–100	113–146
	16¼		18	120	994	70–100	154–189
	18¼		24	100	1338	70–100	207–256
	20¼		24	100	1674	70–100	259–320
D-2 Duplex Compound, Belt Driven	10¼	16¼	12	160	444	80–100	65–72
	11¼	18¼	14	155	638	80–100	93–104
	14¼	22¼	18	120	925	80–100	134–150
	15¼	25¼	18	120	1205	80–100	174–194
	17¼	28¼	24	100	1622	80–100	235–263
	18¼	30¼	24	100	1857	80–100	269–300
	20¼	32¼	24	100	2130	80	309
E Straight Line, Belt Driven	6		6	150	29	45–100	4–6
	8		8	150	69	50–100	9½–14
	10		10	150	134	55–100	19–27
	12¼		12	150	233	60–100	35–47
J-1 Duplex, Belt Driven	6		6	150	58	50–100	7–11
	8¼		8	150	140	55–100	19–27
	10¼		10	150	272	60–100	39–53
	12¼		12	150	472	60–100	67–90
	14¼		14	140	680	65–100	101–130
	16¼		16	135	986	70–100	153–190
J-2 Duplex Compound, Belt Driven	7	10	6	150	81	80–100	12–14
	9¼	14¼	8	150	215	80–100	31–35
	10¼	16¼	10	150	348	80–100	51–57
	12¼	18¼	12	150	526	80–100	77–86
	14¼	22¼	14	140	841	80–100	121–138
	16¼	25¼	16	135	1205	80–100	176–198

rheostat and fuses or circuit-breakers are generally mounted on a slate panel supported by angle-iron or pipe frame work.

Air compressors are inherently slow-speed machines so that a small motor pulley for belt driving is necessary. The belt is generally short and an idler pulley is used to secure the necessary arc of contact of the belt on the motor pulley.

The accompanying table gives the characteristics and horsepower requirements of a well known line of compressors.

There are several governing factors in the design of air lifts, which are important from the standpoint of efficiency and economical operation. In general the ratio of the main pipe of the lift to that of the air pipe should be about 0.16 and

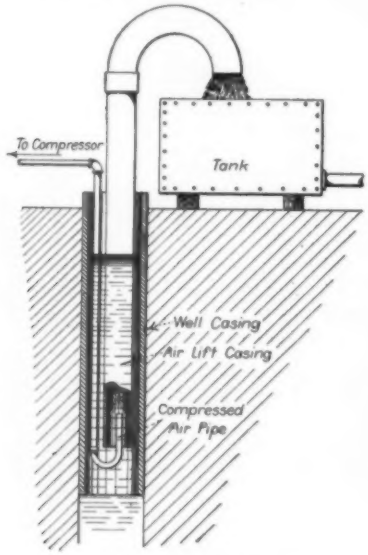


Diagram of Air-Lift Pump.

the submerged portion of the lift, that is the pipe below the surface of the liquid, should be from 55 to 80 per cent of the total length of the pipe with 65 per cent as about the most economical figure. It is also well to keep the velocity of the air within 4,000 feet a minute and where the height of the lift exceeds 180 feet to use two air-lift pumps in series.

Formulas for determining the amount of air required and for calculating the amount of water that will be lifted when the other factors are known are:

$$C=HW\div 16.8, \text{ and}$$

$$W=8.24CS\div H^2, \text{ in which}$$

W=Cubic feet of water raised per minute,
C=cubic feet of air required per minute,
H=height of lift above water level in feet,
S=submergence in feet.

Assume that it is desired to raise 100 cubic feet of water a minute to a height of 100 feet. As 100 cubic feet of water are equivalent to 643 gallons per minute, or 925,920 gallons in 24 hours, then substituting in the first formula,

$C=100\times 100\div 16.8=595.2$ cubic feet.

Referring to the air compressor table we find that a J-1 duplex with a capacity of 680 cubic feet per minute comes the closest to meeting the requirements and that the maximum horsepower needed is 130, which will be the size of the motor required.

To illustrate the working of the second formula assume that we have available an air-lift pump with a lift of 80 feet and a submergence of 50 feet, and an air compressor capable of delivering 100 cubic feet of air per minute. Then the amount of water lifted a minute will be,

$W=(8.24\times 100\times 50)\div 80^2=6.4$ cubic feet.

The accompanying chart shows the amount of air required in cubic feet per minute to lift water to heights up to 200 feet in quantities from 25 to 175 cubic feet per minute. To use the chart follow the horizontal line representing the

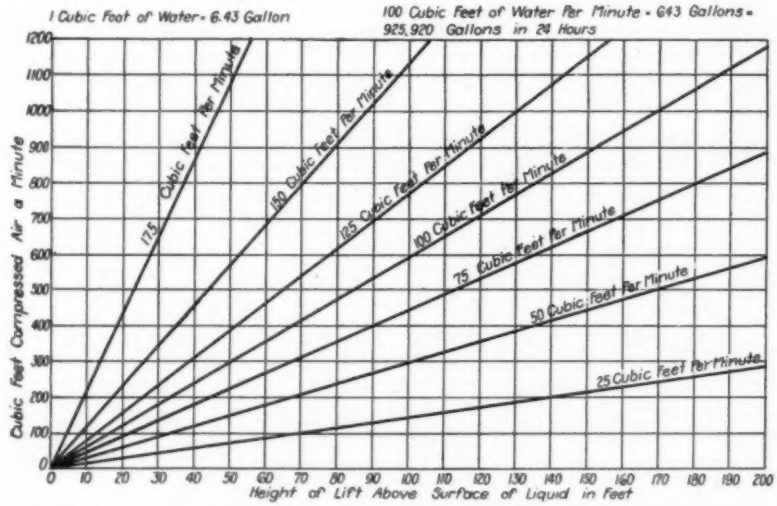

1 Cubic Foot of Water = 6.43 Gallon
100 Cubic Feet of Water Per Minute = 643 Gallons = 925,920 Gallons in 24 Hours
Cubic Feet Compressed Air a Minute
Height of Lift Above Surface of Liquid in Feet
175 Cubic Feet Per Minute
150 Cubic Feet Per Minute
125 Cubic Feet Per Minute
100 Cubic Feet Per Minute
75 Cubic Feet Per Minute
50 Cubic Feet Per Minute
25 Cubic Feet Per Minute

Chart for Computing Amount of Air Required for Lifting Water Various Heights.

height of the lift to the left until it intersects with the diagonal representing the quantity of water to be lifted; the cubic feet of air required will be found in the horizontal row of figures at the bottom of the chart.

Electric Sign As Business Getter.

Interesting use of the electric sign by which one mercantile district invades another is to be noted in Louisville, Ky., where the Market Street Improvement Association has gone into Fourth Street with a big sign in an effort to divert trade from that thoroughfare to the other. The plan was decided upon at the last meeting of the Market Street Association, composed of the retail merchants on that street, and the decision provided for displaying on the big board of the Federal Sign System the slogan: "It pays to buy on Market Street." This is the trade-getting motto which has been adopted all up and down Market Street, is used in the advertising of all these companies and proving to be a trade-getter. The sign is on Fourth Street, between Walnut and Chestnut Streets, at the rear of Lincoln Park, a small breathing space next to the Government Building. It is exceedingly conspicuous.

Successful Percolator Sale in Lancaster.

A special sale of electric coffee percolators has produced highly gratifying results for the Edison Electric Company, of Lancaster, Pa. A small reply post card accompanying the customers' electric light bills on March 1 carried the announcement that a regular standard $5 Westinghouse percolator would be sold during the following 60 days at the low price of $2.98. This advertising effort was accentuated by a large illuminated bill board in the city "Square" as well as by a large poster card, 22 inches by 28 inches, conspicuously and freely displayed, bearing similar announcement. Two window displays in operation during the sale were designed to give further publicity to the sale. A percolator folder with special imprint also accompanied the April 1 bills.

The company's outside sale force was instructed to call the customer's attention to the sale, but a strict canvass was imposible for various reasons and was, therefore, not followed out.

When tabulations were made at the close of the sale on April 30 a record of 203 percolator sales had been made. These figures were considered very satisfactory, especially in view of the fact that during the preceding ten or twelve months two Philadelphia newspapers had given away in the Edison Company's territory as premiums with their papers more than a thousand (non-electric) percolators.

Appliance Campaign in Philadelphia.

Encouraged by a vacuum cleaner campaign during which 862 machines were sold in a single month, the Philadelphia Electric Company is now concentrating its efforts on the sale of three appliances, selected with a view to their convenience for summer use. Special prices are made on a standard electric iron, a toaster and a utility grill, either separately or in combination, and easy terms are allowed when desired.

As in the cleaner campaign, extra advertising is being run in the newspapers and special leaflets are being sent by mail to prospects.

Special attention is also being given the sale of electric fans both for homes and business. Advertising directed to storekeepers contains the suggestion, "Don't wait to swat the fly. Install electric fans in your store and keep the flies out."

Electrical Power in Norway.

The latest available statistics show that on June 30, 1914, there were 1,427 electric power plants in Norway, with a total capacity of about 560,400 kilowatts. About 61,100 kilowatts were used for lighting and 228,900 for electrochemical purposes. During 1914 172 new electric power plants were completed.

According to the latest estimate, the whole of Norway has at least 6,000,000 horsepower easy to develop by hydroelectric works. Of this 750,000 horsepower was already developed in 1913, and by this time the amount is probably over 850,000. The per capita horsepower for all Norway is estimated at 3 horsepower. Further development is hindered by the sparseness of the population, necessitating extensive wiring. The people want electric light, but are not educated to the uses of electric power for other purposes, and lighting alone cannot be made to pay. All the canneries in Stavenger City employ electric power.

A feature of the Norwegian law is the provision which requires electrical waterpower plants to give 5 per cent of their power to the state and 5 per cent to the municipality.

Berlin's Battery-Driven Barges.

A type of long, shallow electric freight barge is in considerable use for carrying bricks and other building material to Berlin. It is stated to give good service on trips of about seventy miles, at an average rate of three miles per hour. The hull is of steel, 123 feet long, 14.5 feet beam, and 6 feet deep, with a draught of less than 5 feet, and each barge has a displacement of 250 tons. A special lead-lined ventilated battery chamber in the stern measures 14 by 10 by 5 feet, and provides accommodation for a storage battery of 80 cells, each weighing 265 pounds. The cells, which have a capacity of 800 ampere-hours, supply current to an eight-horsepower motor, driving the propeller at 120 to 150 revolutions per minute.

Electrically Operated Machinery Used in Building Baseball Park.

Construction of the "Braves Park," for the Boston National League Baseball Association, now going forward, is of reinforced concrete. The grand stand and pavilion will have a seating capacity of 45,000, claimed to be the largest in the United States devoted to the uses of "the national game."

Concrete Tower, Motor-Driven Mixer and Elevator for Building Grandstand.

Concrete is mixed and elevated by means of two Ransome mixing machines with towers 60 and 75 feet high, respectively. The material is discharged from the elevator into a hopper near the top of the tower, flowing thence by gravity to the work through chutes. Each machine has a capacity of about 200 cubic yards of concrete a day, and is operated by a 35-horsepower Westinghouse induction motor on 220-volt energy obtained from the Boston Edison Company.

A field sawmill, where lumber is cut and trimmed preparatory to constructing the forms for concrete work, is operated by a seven-horsepower General Electric induction motor. A temporary transmission line was constructed across the grounds.

Central-Station Power for Unloading Ships at Low Tide.

Ten Reno freight elevators for unloading goods, by hand trucks, from discharging steamers, are installed at piers of the Merchants & Miners Transportation Company at Boston, Mass.

The conveying apparatus, which carries the loaded trucks up inclined gangways, is operated principally when the tide is low, as at other times the gangway is sloping toward the dock. The gangways are suspended on chains and are adjusted to suit tide conditions, which here have a range of 8 to 11 feet. A 10-horsepower Otis motor, operating on 440-volt, three-phase, 60-cycle energy obtained from the Boston Edison Company, drives each conveyor. Motor and starting switch are installed in separate wooden boxes, with inclosed belt connecting with the gear pulley. The starting apparatus gives two speeds to the motor, of 600 and 1,200 revolutions per minute. Each conveyor accommodates 7 or 8 trucks at one time.

Line Extension at Minneapolis.

Work has been started on a transmission line by the Minneapolis General Electric Company which will connect the communities of Osseo, Rockford, Delano, Watertown, St. Bonifacius and Waconia to its lines. The line which will be 65 miles in length will be completed, it is expected, by November 1.

During the week ending June 4 the company secured contracts for 279 customers with 186 kilowatts lighting load and 110 horsepower in motors and took orders for wiring 39 already built houses. During the week a net gain in connected motor load of 900 horsepower was made, including 621 horsepower for the Minneapolis Steel Machinery Company, 140 horsepower for the City of Minneapolis, 110 horsepower for Swift & Company and 25 horsepower (additional) for the Minneapolis Tribune.

Commonwealth Company Displaces Municipal Plant.

By a vote of 228 to 94 the city of Winnebago, Minn., has abandoned municipal electric lighting. By that large majority the citizens decided to dispose of the municipal distributing system to the Commonwealth Power Company, of Mankato, for the consideration of $10,000, and to give the company a franchise to furnish light and power to the city. The decision of the voters was reached after a stringent campaign. The election was held under a law passed at the last legislative session. The company will immediately proceed to extend its line from Amboy to Winnebago.

Electrical Construction

Specification Form for Residence Wiring.

The Minneapolis Electrical Board has prepared a standard form of specification and schedule for residence wiring for the convenience of house owners, contractors and others in arranging for bids on electrical wiring.

The Minneapolis Electrical Board was organized about two years ago, and is made up of the chief electrical inspector of the city and representatives of the central station, electrical contractors, jobbers, supply dealers, electric fixture dealers and electric sign manufacturers. Its purpose is to act as a neutral body for various electrical interests of the city and develop the industry along broad lines.

Specifications for house-wiring have been formulated and following this is a blank schedule shown herewith, providing for the number of outlets and the equipment in each room of a residence building. The schedule is followed by directions for filling in. The specifications are as follows:

Specifications for Residence Wiring.

Bids are requested for furnishing and installing all electrical equipment as hereinafter specified for the ..... residence, located at ..... and being the property of ....Bids are to be addressed to..... and submitted not later than .....day of ....., 19....

I. GENERAL CONDITIONS.—No fixtures, drop cords or sockets are included in these specifications, but all switches and receptacles are to be furnished and installed, and installation made complete from point of service entrance to the fixture outlets. All work must be done in accordance with the City Electrical Ordinance, and with the published "Regulations for Electric Service" now in effect as issued by The Minneapolis General Electric Company, and subject to the approval of the owner and the City Electrical Inspector.

The owner reserves the right to reject any or all bids.

II. SERVICE.—Contractor will be held responsible for obtaining from The Minneapolis General Electric Company, the correct location of the service entrance and also the kind of service which will be available.

III. METER CONNECTIONS.—Provisions for the meter or meters should be in accordance with "Article V, Meters," in "Regulations for Electric Service." Meter boards should be built in as part of the house and, preferably, should be placed in position before the walls are plastered. Meter wires should be carried through the board from the rear at points convenient for connecting to the meter or meters. All meters are to be located in rear hall or basement.

IV. RECEPTACLES AND THEIR CAPACITY.—Receptacles shall be of 10 amperes capacity, having an insulated barrier between their two live parts.

V. CUTOUTS.—Branch cabinets should be placed in a dry, accessible location, not adjacent to plumbing fixtures.

VI. FIXTURES.—To provide a stable foundation for fixtures where gas pipe is not present, a board should be securely fastened between joists and immediately back of the lath and plaster wherever outlets occur. Those wires which are to be used by the fixture hanger should be indicated with a tag securely fastened to the ends. All other splices should be soldered and taped by wiring contractor.

VII. JOINTS.—All joints and connections must be well made, soldered and thoroughly insulated with rubber and friction tape.

VIII. LIGHTING CIRCUITS.—Where an applicance circuit is specified (See Article IX), 16 sockets may be used on each lighting circuit, but if no appliance circuit is provided, only 12 sockets will be permitted on each lighting circuit. Contractor, in designing his circuits, should consider only the *maximum* number of sockets stipulated in the column "Sockets."

IX. APPLIANCE CIRCUIT.—An independent circuit to be used exclusively for electric appliances shall be run from the branch circuit cabinet with No. 14 wire to provide service for the baseboard and wall receptacles stipulated in the schedule below. This schedule calls for only the essential equipment which every residence should have, and does not include the many additional features which may be added at the option of the owner.

Directions for Filling in Specifications.

1. Send two sets of specifications to each of two or more contractors for bids. Care should be taken that all copies are alike.

2. Fill in the blank spaces in first paragraph of specifications.

3. Draw a line through the name of each room in the Schedule which does not appear in your house.

4. If you wish to change the equipment designated for any particular room, draw a line through the printed name and write the name of the room in one of the blank spaces provided under "Changes or Alterations" and opposite it insert figures in the columns which will give you the equipment desired.

5. If the schedule does not include all the rooms which appear in your house, insert the name of the rooms in the blank spaces provided under "Additions" and designate by figures, in the proper columns, the equipment desired.

6. The contractor will insert the amount of his bid, sign the specification and return both copies. Upon awarding the contract, the owner will signify his acceptance by signing and returning one copy to the successful bidder.

7. When selecting fixtures, show your copy of the specifications to the fixture dealer, and he will then know the number and capacity of the fixtures for which your house is wired.

8. The column "Total Watts" refers to the approximate aggregate size of the lamps needed to provide suitable illumination, i. e., "Living room, 200 Watts," may be lighted with five 40-Watt lamps, or one 60-Watt and four 40-Watt lamps, or two 40-Watt and four 25-Watt lamps, etc. In houses with small rooms, the wattage stipulated may be greater than necessary.

9. The Sales Department of The Minneapolis General Electric Company, or any reliable electrical contractor, will gladly give you further information. They are interested in seeing that you obtain only what will best satisfy your requirements.

We, the undersigned, hereby agree to furnish and install the above in accordance with all the regulations imposed under these specifications for the sum of ..... ($.....) Dollars, payable as follows: .... but in no case shall final payment be required, until all work is completed in accordance with this specification.

Firm .....

By .....

Address .....

Telephone .....

Accepted by

Owner .....

Date....., 19....

SCHEDULE

ROOMS	LIGHTING CIRCUITS											Appliance Circuit			Bell Circuit		REMARKS
	Ceiling Outlets Controlled by Wall Switch	Ceiling Outlets (Without Switch)	Wall Outlets Controlled by Wall Switch	Wall Outlets (Without Switch)	Flush Wall Switches	Snap Wall Switches	Pair Flush Three Way Wall Switches	Total Number of Outlets (Lights & Switches)	Total Number of Switches	Sockets	Total Watts	Baseboard Receptacles	Wall Receptacles	Total Receptacle Outlets	Bell or Buzzer	Push Button	
Porch—Front	1	—	—	—	1	—	—	2	1	1	25	—	—	0	—	1	
Porch—Rear or Side	1	—	—	—	—	1	—	2	1	1	25	—	—	0	—	1	
Reception Hall	1	—	—	—	—	—	1	3	2	1 to 3	120	1	—	1	—	—	
Parlor	1	—	—	—	1	—	—	2	1	1 to 5	160	1	—	1	—	—	
Living Room	1	—	—	—	2	—	—	3	2	1 to 7	200	1	—	1	—	—	
Dining Room.	1	—	—	—	1	—	—	2	1	1 to 5	160	1	—	1	—	1	
Kitchen	1	—	—	1	—	1	—	3	1	1 to 3	120	—	1	1	1	—	
Pantry	—	1	—	—	—	—	—	1	0	1	25	—	—	0	—	—	
Bed Room No. 1	1	—	—	2	1	—	—	4	1	1 to 3	100	—	—	0	—	—	
Bed Room No. 2	1	—	—	1	1	—	—	3	1	1 to 3	80	1	—	1	—	—	
Bed Room No. 3	1	—	—	—	1	—	—	2	1	1 to 3	40	—	—	0	—	—	
Bed Room No. 4	1	—	—	—	1	—	—	2	1	1 to 3	40	—	—	0	—	—	
Bath Room	—	—	2	—	1	—	—	3	1	1 to 2	50	—	1	1	—	—	
Upper Hall	1	—	—	—	1	—	—	2	1	1 to 2	60	1	—	1	—	—	
Third Floor	1	—	—	—	—	1	—	2	1	1 to 2	25	—	—	0	—	—	
Basement	2	—	—	—	—	1	—	3	1	2	50	—	—	0	—	—	
Laundry	1	—	—	—	—	1	—	2	1	1	60	—	1	1	—	—	
Changes or Alterations																	
Additions																	
Totals																	

Upon the back of the sheet are given recommendations for assistance in determining upon the necessary equipment, as follows:

Recommendations for Residence Wiring.

These recommendations are issued for the guidance of those contemplating the installation of electric service in an average-sized residence. Many of the conveniences and economies in the use of electric service cannot be obtained unless the wiring is intelligently designed and installed. It is the intention to acquaint the prospective consumer with the essentials of a good, simple installation. The reverse side of this sheet is in the form of a specification to be used in obtaining figures from as many contractors as desired. On this side will be found explicit directions for filling in the blank spaces provided. Two copies should be sent to each contractor from whom bids are requested, and it is recommended that they be sent to at least two firms. By the use of this specification, contractors will bid on specifications that call for definite material and workmanship and the owner will be in position to decide which firm should obtain the business.

To enable the owner the better to fill in the specification, a brief description of the equipment which should be included in the various rooms of a three to eight-room house, is outlined below.

Appliance Circuit.—This is a circuit to supply current for operating toasters, flat irons and other electric appliances. When installed at the time the house is wired, it seldom adds anything to the cost, as the number of lighting circuits can be reduced in any installation when a circuit is provided for the use of appliances. With the rapid growth of electric appliances, an independent circuit for their use is becoming essential.

Porch.—The light is generally located on the ceiling and controlled by a switch just inside the front door. This light is desirable for illuminating the porch and house number and also affords to the house and its occupants certain protection from burglars.

Reception Hall or Parlor.—A center ceiling outlet controlled by a switch located adjacent to the porch light switch, and also a second switch at the head of the stairs. By means of this arrangement the hall light may be turned on or off from either downstairs or upstairs. These are what are known as "three-way" switches. In a one-story house a three-way switch is not required.

Living Room.—A center ceiling outlet controlled by a double wall switch located near the entrance to the room. By the use of two switches on the center fixture, part of the illumination can be dispensed with when not needed, where with but one switch it would be necessary to burn all the lights or none at all. A baseboard receptacle is also convenient for the attachment of a table lamp, a fan or a vacuum cleaner.

Dining Room.—A center ceiling outlet controlled by a wall switch is essential. If desired, wall outlets may be provided for decorative lighting. A baseboard receptacle is recommended for a toaster and other cooking utensils.

Kitchen.—A center ceiling outlet controlled by wall switch located near the entrance door will provide general illumination. One or more wall outlets are convenient when placed near the sink or table. Also a wall receptacle is needed for an electric flat iron or kitchen utensils.

Pantry.—A center ceiling outlet for general illumination. This may be controlled by a key or chain socket or by wall switch.

Upper Hall.—Either ceiling or side wall outlet for general lighting of the hall and stairway, controlled by a switch placed at the head of the stairs near the three-way switch controlling the reception hall light downstairs. If desired, this light may also be controlled by three-way switch located at the foot of the stairs.

Bed Rooms.—A ceiling outlet for general illumination and controlled by a wall switch located near the entrance door. One or more wall outlets may be provided for special illumination. A baseboard receptacle may be installed for convenience during sickness.

Bath Room.—One or, preferably, two wall outlets located on either side of the mirror and controlled by a wall switch. If desired, a baseboard receptacle will be found convenient for an electric water heater, a curling iron or vibrator.

Basement.—One or more outlets controlled by a switch at the head of the stairs. This enables you to enter or leave the basement in safety.

Laundry.—A ceiling or side-wall outlet for general illumination. There should also be a wall receptacle to operate a washing machine or a flat iron.

General.—Wall switches are a great source of convenience and they add little to the cost of installation. The flush-type push-button switch is recommended except for the attic or basement, where the snap-type switch (which is slightly cheaper), may be used.

Consideration of these suggestions will add materially to the convenience and economy of electric service. It is hoped that this information will enable the consumer to take advantage of many desirable features which are often lost sight of or purposely omitted by a contractor in order that he may obtain the business by doing it at a lower cost. When bids are requested from several contractors and each contractor is bidding on the same specification, he is bound under the contract to provide certain equipment and to install it as stipulated. Under this arrangement he cannot take advantage of the consumer's ignorance by giving him an installation with which he can only partially realize the many advantages of electric service.

In building a new home the entire electric installation forms an item of approximately only two per cent of the cost, and the little additional expense required to provide a complete system is entirely out of proportion to the advantage and comfort which it adds to the home.

Store of Independence Electric Supply Company.

New Quarters for Independence Company.

The Independence Electric Supply Company has recently moved into new quarters on West Lexington Street, Independence, Mo., where a long show window gives exceptional opportunities for displays. During June the company is especially displaying electric fans, with the fixtures quite clearly visible overhead from the road. West Lexington Street is on the National Old Trails Road, the chief thoroughfare for transcontinental automobile travel to the California fairs.

An exterior view of the new store is shown above.

Bureau of Standards to Investigate Fuse Question.

Notice of a public hearing on a joint appeal of Underwriters' Laboratories and the Economy Fuse and Manufacturing Company to the Bureau of Standards has been issued by the acting director of the Bureau to manufacturers of cartridge fuses, and to electrical inspection departments of municipalities and underwriters' associations, as follows:

Underwriters' Laboratories and the Eonomy Fuse and Manufacturing Company have jointly appealed to the Bureau of Standards for decision on the following question:

"Has it been shown that the use of the fuses manufactured by the Economy Fuse and Manufacturing Company results in no greater fire or accident hazard than the use of other cartridge inclosed fuses at present listed as standard by Underwriters' Laboratories?"

The evidence on which the decision will be rendered will include that which is presented by Underwriters' Laboratories, by the Economy Fuse and Manufacturing Company, by any other manufacturers of cartridge-inclosed fuses, and by state, city, or insurance inspectors—all such evidence being subject to investigation or check by the Bureau of Standards as it may see fit.

In accordance with this arrangement there will be a public hearing at the Bureau of Standards, Washington, D. C., July 8, 1915, beginning at 10 a. m. You are invited to be present at this hearing and to present any statements of fact or results of experience which have a direct bearing on the question at issue. Written statements will be received by the Bureau on or before the above mentioned date in lieu of personal attendance at the hearing. Written arguments in rebuttal of any statements made at the hearing may be filed with the Bureau within 15 days after the date of the hearing.

Inspection in Boston.

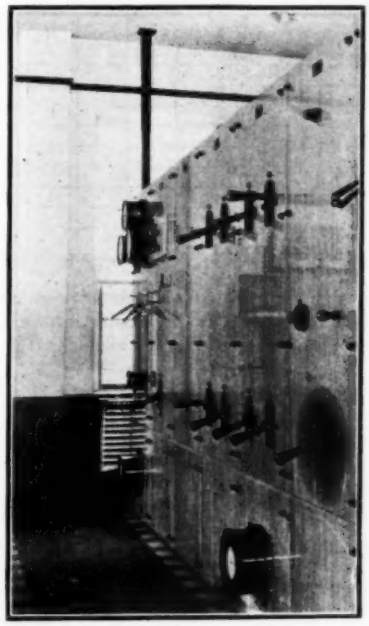
The Massachusetts Legislature, recently prorogued, passed an act which authorizes the Boston Wire Commissioner to collect reasonable fees for all permits and licenses issued by him, and for the inspection of electrical work done under these licenses and permits. The same official is given exclusive authority to grant location for underground wires, cables and conduits, and has authority after hearing, to direct alteration in locations.

The City Council of Everett, Mass., is empowered to designate an official, to have exclusive authority to supervise the removal of all wires and cables and poles from specified streets.

A Model Factory Substation.

The increasing motor-equipment of industrial plants with central-station service calls for substation provision by which the energy is switched, measured and controlled with best efficiency, and at the same time with the maximum of simplicity and safety. These conditions have been met admirably in the case of the Coes Wrench Company, at Worcester, Mass., where a substation that might serve almost as a model for similar factories is operated to provide for this extensive plant, producing wrenches and machine knives of high quality.

The structure is of brick with slate roof, recently erected, near the street in a corner of the mill yard. The dimensions are 20 by 22 feet, the building consisting of a single 12-foot story and a basement 6.5 feet high.



Switchboard of Coes Wrench Company.

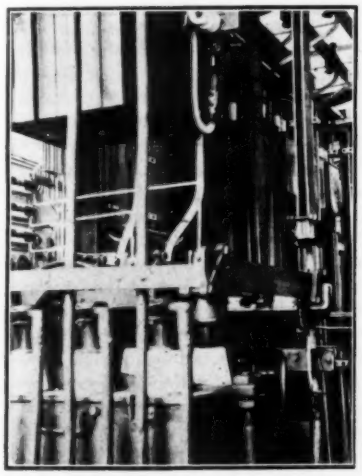
The upper or ground floor is divided into a switchboard room and a compartment for the transformers and a motor-generator. The basement is devoted to the housing and classification of the power lines, and here the noteworthy feature is the ready accessibility of the incoming and outgoing lines and the switchboard connections.

The Worcester Electric Light Company's 2,300-volt cables enter the basement and are carried through iron conduit, which follows the wall and ceiling, to a 2,300-volt switch on the board. Thence the lines pass to the transformers through bushings in the floor; thence back to a 440 and 110-volt switch on the board; thence to the buses at the back of the board, whence the individual power and lighting circuits are

fed through their respective oil switches.

The switchboard room, which is 20 by 11.5 feet, contains a gray marble switchboard, 14 feet long, and set 4 feet 10 inches in front of the partition wall, giving a minimum clearance of 2 feet 9 inches between the fittings and the wall. There are two main circuit control panels and other panels each carry a switch which controls a department in the mill. The services to the mill are contained in fiber conduit laid in the ground in cement; the lines as they leave the basement are brought together in a concrete duct erected on brick piers about three feet above the floor. The five power circuits are mainly of No. 2 copper. One feeder provides for 110-volt lighting service and runs to feeder boxes in the several departments, whench individual circuits are distributed.

The substation transformer equipment consists of three 50-kilowatt General Electric units rated at 2,300/440 volts, and one 20-kilowatt Westinghouse transformer rated at 2,300/110

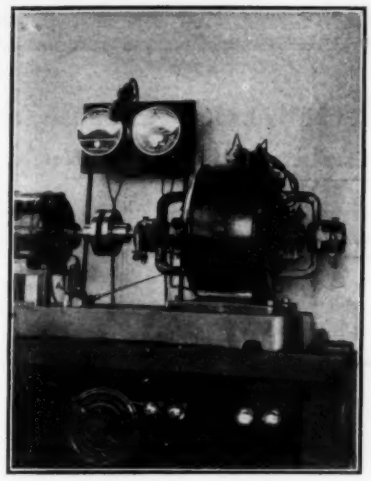


Back of Switchboard.

volts. A Holtzer-Cabot motor-generator, rated at one kilowatt, provides alternating current to ring the call-bell system in the mills, and direct current for charging telephone batteries and energizing magnetic chucks in the wrench works.

The switchboard room is lighted by four 60-watt Mazda lamps installed near the ceiling in Holophane reflectors and by three 25-watt Mazdas on wall brackets 7 feet above the floor. The transformer room, which is 20 by 10 feet, is lighted by two 40-watt units at the ceiling and a 25-watt wall-bracket lamp.

The Coes plant includes a second factory group, a quarter of a mile distant from the substation and Mill No. 1. This group is provided with power service by a 2,300-volt line of No. 2 hard-drawn copper wire installed on



Motor-Generator Set.

five 60-foot steel towers. The cables are tapped off the incoming central-station mains in the substation basement and are carried in two-inch iron conduit to join the aerial cables at specially designed dead-end brackets secured to the wall under a slate-roofed projecting hood with about 18 inches overhang. The cables emerge from the substation through bushings which are set in the under side of this hood, which provides a protection from snowslides and from ice-formation in storms of freezing rain.

The transmission line terminates at the last of the five towers in a pothead and two-inch conduit runs to a manhole at the foot of the tower, whence it is carried in fiber duct laid in concrete, through two manholes in the yards, to the mills. The elimination of aerial wires is obviously of advantage in case of fire.

A transformer house at this mill contains three 150-kilowatt Westinghouse units which provide for the step-down of the 2,300-volt primary potential to 440 volts for motor service. Lighting

Outgoing Lines of Transmission System.

wires are carried on the transmission towers from the substation.

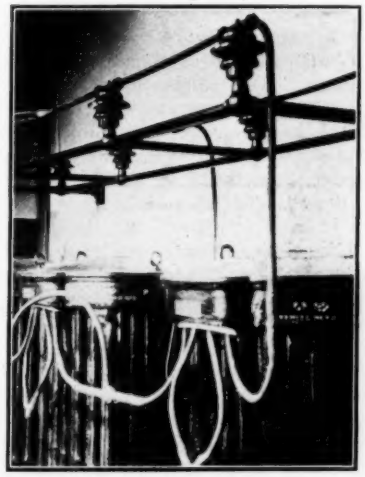
Edward Searle is the company's electrician.

Wooden Molding Barred From Louisville.

According to the announcement of the city building inspector of Louisville, Ky., the provision of the code which will prevent use of wood molding in wiring buildings anywhere in the city, and the supplemental regulation of the county and insurance authorities against use of wood for this purpose anywhere in the county, becomes effective on July 1. The contractors of the city had four months to make ready for the change and the end of June will find stocks of wood molding exhausted.

Among the Contractors.

The Childers & Waters Electrical Company, Louisville, Ky., has become local distributor, the territory including Kentucky and a part of Indiana, for the



Transformers in Substation.

"Brascolite" line of fixtures. Right away the company received an order for installation of four and another for ten, one of these to go in a private residence. C. C. Childers thinks so well of the fixture as a dining-room lamp that he is installing one in his own home.

The Harry I. Wood Company, Louisville, Ky., has just contracted for installation of the lighting systems for the Louisville & Nashville Railroad Company in a new freight station, a new passenger station and yards at Lewisburg, Tenn., as well as for 17 one-lamp lighting standards in the yards. This company has begun wiring at the mill of Gamble Brothers, lumber dealers and mill men, in Highland Park, south of Louisville, for the electrification of that property. This installation calls for about 200 horsepower.

Public Service Commissions

Conducted by William J. Norton

COLORADO.

The Colorado Springs Light, Heat and Power Company has been notified that an investigation into the reasonableness of the rates, rules and regulations and practices of the company, and into the adequacy of the service has been instituted by the Commission.

DISTRICT OF COLUMBIA.

The Potomac Electric Power Company was authorized to discontinue the payment of interest on a deposit as soon as a depositor ceases to be a customer. The Company is to place on its bill closing the account of a customer the notice: "Please call for deposit if one has been made."

Chesapeake and Potomac Telephone Company. A preliminary injunction to prevent the Chesapeake and Potomac Telephone Company from terminating a contract for unlimited flat-rate business service, was denied by Justice McCoy of the District Supreme Court in a decision rendered June 18. When the public utilities act went into effect there were about two hundred of the flat-rate contracts, as compared with 6,900 measured-rate business contracts. A test suit was brought on behalf of the holders of the flat-rate contracts, asking that the company be enjoined from terminating the contract until a lawful hearing and determination of the question of rates had been held by the Public Utilities Commission.

IDAHO.

Investigation of Electric Rates. The investigation to determine rates for electric service in southern Idaho has been postponed until October 11, 1915. This action was taken because of the changing situation incident to the transfer of property and consolidation of interests going on among the power companies involved.

The Electric Investment Company has purchased the properties of the Idaho Railway, Light and Power Company as another step in the merging of the southern Idaho power companies.

NEW JERSEY.

Public Service Gas Company. The Court of Errors and Appeals, on June 14, by a vote of six to four, reversed its decision in the Passaic Gas case, which was reported in ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, December 19, 1914.

Upon rehearing, the court upholds the decision of the Supreme Court and the order of the State Board of Public Utility Commissioners fixing the price of gas in the Passaic Division at 90 cents a thousand cubic feet.

The court also reversed the decision of the Supreme Court in dismissing the writs of certiorari sued out by Paterson and Passaic to review the decision of the Board. The cities originally asked for an 80-cent gas rate.

The company's representative has stated that the case will be carried to the Supreme Court of the United States.

The most important principle involved in the case was that of allowing franchise value in a rate case. The Court, in reversing its former decision, upholds the Board, in finding that no franchise value should be added in valuation for rate-making. A concurring opinion was filed by Judge White, in which he gives his views on franchise value. He says: "The plain fact is that the commercial value of the company's property right in its franchise can have no effect in fixing the rate it can charge, because by the terms of its contract with the state the stream of its franchise value arises from the spring of its right to charge 'reasonable rates,' and in the very nature of things no stream can rise higher than its source." He states that it is preposterous to hold that the property right to charge "reasonable rates" should by virtue of its own existence have the effect of converting itself into a still more valuable property right to charge unreasonable rates. "Presumably the incorporators went into this public utility business because they expected that their charter privilege to charge 'reasonable rates' for the gas they were to manufacture, distribute and sell, would be a valuable one, but that fact and the fact that it has become so cannot have the effect of altering the terms of the contract made with the state. The mere statement of this proposition is sufficiently convincing, but if anything more were needed, a glance at the absurd practical result of the contrary view would be illuminating.

"If the franchise to charge 90 cents in order to pay 8 per cent on the value of the company's property, not including the franchise, is worth a million dollars and must be included and have 8 per cent paid on it also, the rate would have to be $1, instead of 90 cents; but if the company has the property right to charge $1 the franchise is worth two million dollars instead of one million, and so the rate must be $1.10 in order to pay 8 per cent on the additional million, and so on indefinitely."

It is reasoned by Judge White that because the state omits for a great number of years to enforce a price, and thus allows the company to charge unreasonably high rates, and there seems every likelihood that this permission of omission will continue, the property value of the company's franchise in the open market, as reflected by the market value of the company's stock, would be much higher than it would be if the state had at all times and consistently enforced its rights, and there was every prospect that it would continue to do so. The opinion continues: "Assuming, for the purpose of illustration, that an unreasonably high rate has been charged by this company in the past, upon what theory can it be contended that because of this permissive omission on the part of the state in favor of the company during all these years, the state has now forfeited the rights of the public to enforce a condition which it was always the duty of the company to perform, whether the state compelled it to do so or not? I think there is none. I suppose it may fairly be assumed that with all the other conditions exactly as they were in this case at the time of the order, if the rate charged by this company in the district in question before the order, had been $1.40 instead of $1.10, the claim of the company to be allowed for value of franchise would have been at least double in amount what it now is, and that the higher property value, as indicated by market value of securities, and by a valuation of franchise for taxation, would have more than substantiated such enlarged claim. Clearly no part of such increase of claim could have any proper foundation for consideration in arriving at a just and reasonable rate, although it would have all the property-right backing now urged for the present claim.

"I think we may properly conclude, therefore, that the charging of unreasonably high rates in the past, if they have been so charged, can furnish no ground for the continuation of these rates in the future, and this, although a

shrinkage of commercial and taxing value of the franchise, will be the state's enforcement of its contract right to require the rates to be reasonable in the future."

NEW YORK—Second District.

New York and Vermont Home Telephone Company. In an opinion by Commissioner Carr, the Commission has decided that a charge of 50 cents a month for extension telephones is not an unjust or unreasonable one. The complaint was brought against the New York and Vermont Home Telephone Company. The New York Telephone Company was allowed to intervene and submitted data as to the cost of this service from studies made throughout the state.

The opinion states that the charge of 50 cents a month is the usual charge in the state of New York, and in the entire country, and that in no instance where these charges have come before the Commission have the rates been reduced.

The opinion also says that the accommodation afforded by the extension telephone cannot be exactly measured in dollars and cents.

In regard to the data submitted on costs, the opinion refers to the conclusions of the witnesses of the telephone company, that the placing of an extension telephone increases the number of messages 15 per cent on a flat or messenger-rate line. Taking this percentage of increased business as a basis for the added cost to the company of the extension telephone, further studies all over the state led the telephone witnesses to testify that the added traffic expense was 59.5 cents per year, and added commercial expense 69.2 cents and the annual plant charge $3.13. The opinion says: "In the figures submitted by the telephone company, no amounts were included for workmen's compensation insurance, fire insurance, or for pensions of employees or welfare work, which, it may be assumed, are proper items of expense in a business of this character. If such items are included it might well be that the total operating expense of $4.417 would be increased to more than $5.00 per annum, and there might be contingent expenses which would still further increase this total. It should also be noted that nothing has been included to cover a return on the investment."

WISCONSIN.

The Estella Farmers' Telephone Company applied for authority to enter territory which is already supplied with telephone service. It appeared that the application is based on the contention that the present service is inadequate and unsatisfactory. It was shown, however, that the service was being improved and that the company in the field was in a position to furnish as good a service as could be provided for by the petitioner. The Commission says: "The Commission has frequently stated that a service complaint against an existing company is the proper method to raise for consideration of the service that is being given. We deem it unnecessary to go over that ground. If the service being afforded by any company is so hopelessly bad that there is no possibility of making it adequate, or if a company is in such a weakened financial condition that it appears impossible for it to give the service it has undertaken to give, or if there has been a continued and willful disregard of public requirements in the way of service, or if a company against which a service order has been issued fails to comply with the requirements of such order, then an application for a certificate of public convenience and necessity may be the proper and final resort.

"It has not been disclosed that any of these conditions precedent prevail in the instant case. . . .

"It has not been shown that the extent of service desired by the applicants is in any wise greater than that which may be had by utilizing the opportunity already at hand, nor that the service now offered them cannot forthwith be made entirely satisfactory.

"For these and other reasons, it is deemed that the certificate for which application is made should be refused."

The Marathon City Telephone Company applied for authority to extend its line a distance of about a half mile to reach the residence of one individual. The extension would parallel the lines of the Edgar Cassel and Emmett Telephone Company. The Commission says: "While a limited amount of paralleling may be permissible in instances in which there is a marked public demand for the extension of the lines of the second company, it is so apt to result in difficulties for both companies that it is not generally sound policy to allow it. . . . Indeed, it seems doubtful if the existence of a public convenience and necessity such as would warrant granting permission to extend the lines of a telephone company parallel to existing lines of another company, can ever be predicated upon the application of a single subscriber.

"The likelihood of serious disagreement arising between the two companies if permission be granted for the paralleling considered in connection with the slight occasion for the extension makes it seem unwise as a matter of policy to allow it to be made."

The Commission finds that public convenience and necessity does not warrant the proposed extension.

The Sandusky Telephone Company was granted authority to increase its rate from $10 to $12 per year. There was not sufficient data to determine the investment in the property or the proper operating expenses. The Commission bases its order on the following general statement:

"From its investigation of a number of other cases, the Commission has found that where metallic service is furnished to rural lines, it is usually impractical to furnish adequate service at a rate of $12 per year, but that grounded-line service can sometimes be furnished at such a rate. In no case, however, has a careful investigation indicated that adequate service can be furnished on grounded lines at a rate of less than $12 per year, particularly if the number of subscribers per line is properly limited, as it appears to be on the average of all lines involved in this case

Good Results from Safety Work.

At the recent convention of the National Association of Corporation Schools, at Worcester, Mass., S. W. Ashe, of the General Electric Company, pointed out the importance of having safety work centralized and well organized. He emphasized the value of the foremen's interest, of keeping good records, and of being systematic and continuous in the advancement of propaganda.

He said that results accomplished from systematic safety campaigns have been phenomenal. Electric shocks, eye cases, foot burns in foundries, nail punctures, punch-press accidents and ruptures have been reduced to a minimum. The results to companies and men have been decreased casualty expense, reduction of lost time, less visits to the emergency hospital, etc.

Benefit Association at Pittsfield.

A mutual benefit association is being organized at the Pittsfield, Mass., plant of the General Electric Company. There are already associations in the Lynn and Schenectady plants.

The objects are to provide sick benefit of $6 a week to males and $5 a week to females, operative 14 days in the year; to provide a $100 death benefit; to furnish its members social and fraternal features.

New Plant for Mt. Whitney Company.

The Mt. Whitney Power & Electric Company has let the contracts for the construction of its fifth hydroelectric generating station, to be built on the Kaweah River in the Sequoia National Forest. The new plant, which will generate 10,000 horsepower, will cost $750,000.

Questions and Answers.

All readers of the Electrical Review and Western Electrician are invited to submit questions and answers to this department. Full names will not be printed except where the writer indicates his willingness therefor. Anonymous communications will not be considered. Questions relating to electrical matters of any kind will be inserted. Answers from our readers should be received in this office preferably within ten days of the date of publication of the question, and will be published in a subsequent issue. Payment will be made for all answers published.

Questions.

No. 287.—Powdered Coal as Central-Station Fuel.—Recent experimental trials with powdered coal as steam-boiler fuel are said to have given almost ideal results from the standpoint of combustion efficiency. Has this fuel been tried on any extensive scale under the boilers of any large or medium-sized central station? Is the method applicable advantageously to all kinds of coal? Is the cost of the crushing plant offset by the increase in efficiency?—B. A. M., Toledo, O.

No. 288.—Brush-Brass Finish.—Kindly explain through the Questions and Answers Department, how the brush-brass finish now so popular on fixtures is applied. Why is it not so durable as polished brass? What conditions affect the durability and value of this finish?—G. C. N., Terre Haute, Ind.

No. 289.—Combination Electric Radiator.—I have just heard of a newly patented electric radiator which resembles a hot-water radiator and has an electric coil heat the water in the pipes; it is said to be more economical than a straight electric radiator. I fail to see this and would like to have it proven.—W. T., Cleveland, O.

No. 291.—Insulation of Underground Piping.—It is often claimed that covering underground pipes with a coating of paint is an effective measure against electrolysis. Since paint is supposed to be an insulator, why is it not more often used?—G. D. K., Chicago, Ill.

No. 292.—Sunspots, Magnetic Storms and Weather.—A short time ago a statement appeared in the newspapers that an exceptionally brilliant display of the aurora borealis was connected with great activity in the sun spots and that it also produced serious disturbances on telegraph circuits and magnetic compasses and accounted for our prolonged rainy weather. Has any definite conclusion been reached by astronomers, meteorologists and other scientists as to the interconnection of these phenomena? Is there any basis for ascribing an electrical or magnetic relation between them?—F. L., Beloit, Wis.

Answers.

No. 286.—Static in Press Room.—In the press room of a large printing establishment much trouble was experienced during the dryest part of last winter from static electricity causing paper sheets to stick. Attempts were made to take the static from the driving belts, but without entirely relieving the trouble. A suggestion was made that a humidifying apparatus be put in to keep the air more moist, it being claimed this would immediately stop the trouble. Is this a reliable solution? If not, what is the best way to get rid of the static?—C. A. C., Omaha, Nebr.

In general, there is less tendency in humid air for a leather belt to become electrically charged, but humidifying the air has not always the desired result. Very often the reason for the static charge is that the belt itself is extremely dry. In this case wiping the belt inside and outside with glycerine has a very good result. If, however, this is without effect and the static charge occurs again it will be best to arrange some wires with their points directed against the belt near the place where the heaviest charge occurs and to connect them with the mass of the motor and of the printing press so that the equilibrium between the two opposite charges of belt and pulleys can be restored.—H. A., Pittsburgh, Pa.

The presence of static charge in belt-driven apparatus is dependent upon the complete insulation of the friction surfaces from the ground. Hence, to remove static it is either necessary to ground the belt, in case of wooden-pulley drive, or the apparatus if the pulleys are of metal. Grounding the apparatus may not be effective, if the oil has sufficient resistance to effectually insulate the pulleys from the machine. Graphite offers the best lubricant in this case. Without doubt, the best method is to remove the cause of the static, belt slippage. This may be done by running slack and using a good belt dressing. This not only relieves the static but decreases the power loss in belt transmission. To increase the humidity would be reliable, though not more than other methods, and has the disadvantage of high cost.—H. E. W., Chicago, Ill.

This trouble is to be found on practically every machine on which paper is handled at high speed and is caused by friction between the sheets of paper which generates a static charge. It is therefore readily seem that neither of the remedies mentioned will entirely remove the trouble. A short time ago the writer visited a large press room and noticed a single wire terminating at one of the presses, which the electrician in charge stated was connected to a high-tension step-up transformer, and connected at the press to keep the sheets of paper from sticking together. This removes static trouble entirely and is installed in many of the large press rooms throughout the country. Complete information could, no doubt, be obtained by getting in touch with any electrician in charge of a large press room.—E. Q., Brooklyn, N. Y.

I had a great deal of similar trouble last winter with looms becoming highly charged with static electricity during dry periods, not only from weavers who were getting shocked but the foreman also complained. The constant friction of heddles, harness and threads would so charge the metal heddles that the lint collected on them would work into little balls, sometimes causing the threads to stick and break and at other times getting into the web and making bad work. I will explain my method of ridding the looms of static. I drilled a one-fourth-inch hole and tapped it into the frame of the loom above the harness and attached a shuttle spring (which is a very fine flexible brass spring) to the screw placed into this hole and to the heddle bar; the spring did not hamper the free movement of the harness but conducted the static to the frame of the loom and thence to ground; the looms being grounded. This is a standard attachment which we put on every loom affected that way. To dampen the air would affect our production badly, as it would make everything stick. Try grounding the machine, if necessary. It may help.—W. T. E., Ansonia, Conn.

Where the static electrical conditions interfere with the delivery of paper from a press, causing it to cling, this can be completely overcome by grounding the entire framework of the printing press. This applies particularly to the cradle or traveler which delivers the sheet of paper, and also the framework or stand on which the paper is received. I have had several cases similar to the one referred to by C. A. C. and in each case the trouble was eliminated as outlined. The ground wire should be connected to the nearest water pipe.—W. A. G., Detroit, Mich.

No. 290.—Electric Fishing.—A friend of mine has told me it was possible to arrange electric wires in a fish net so as to greatly increase the quantity of fish caught. Is this prohibited by the fish and game laws?—P. S., Mobile, Ala.

Regarding electrical fishing, as submitted by P. S., Mobile, Ala., I think his friend is trying to play a joke on him because I do not believe that the use of electric wires in a fish net could be used to increase the haul of fish. I think if P. S. will refer to the laws as enacted by the State of Alabama and enforced by the state fish and game warden, he will find that all artificial snares involving the use of electric lights, electric current in any form, and explosives are prohibited. While I am not familiar with the fish laws of Alabama, I know that it is the plan of all state fish and game wardens to prohibit any unsportsmanlike method of catching fish.—W. A. G., Detroit, Mich.

COMPETITIVE ECONOMY TEST OF TUNGSTEN-FILAMENT LAMPS.

Complete Performance Data Covering Test of More Than 250 Lamps, with Discussion of the Engineering Significance of Such Tests and of These Results.

By H. H. Higbie.

Notwithstanding the fact that the electric incandescent-filament lamp is common enough to be familiar to every observing person, very few people have any idea how complex is the history of its development and the process of its manufacture. To the majority a lamp is simply a *lamp*—a thing which gives light when it is inserted in a lamp socket and attached to electric mains. Few people know or realize that the proper selection of a lamp has any relation to the pressure of the circuit, or that such relation is very important in determining the cost of a given quantity of light. Although the central stations and large consumers of lamps are very careful to educate themselves about such matters and to keep themselves informed of all the rapid changes and developments that have been continually ocurring in recent years, it is probable that most lamps are bought or used in ignorance or disregard of facts which have a very great influence upon the cost of light. The resultant economic waste, which is largely preventable, must be in the aggregate enormous.

Entirely aside from this profound influence of conditions of use upon economy of light production by any given lamp, we must recognize also the differences of quality between various brands of lamps, and between various lamps of the same brands. Not less than nine different kinds of material are used to make a tungsten lamp, and improper composition or preparation of any of these may cause premature failure of the lamp. Particularly delicate and important is the manufacture of the tungsten filament itself, the breakage of filaments being sometimes increased several hundred per cent by improper processes and technique in such manufacture. In developing the gas-filled type of lamp, which is commonly used in the larger sizes, special lines of investigation had to be undertaken, resulting in new kinds of glass for the lamps, new methods of treating the glass to remove occluded gases, and new shapes for the bulbs. Even new cements for fastening the bulb to the brass shell had to be investigated.

Consider also that there are not less than sixty steps in the manufacture of a lamp, and that the quality and performance of the finished product, as well as the wastage in manufacture and consequently the cost of a lamp, depend very greatly upon careful work by a large number of individual employees who handle each lamp, and upon delicate adjustments of much special machinery. It is then not difficult to understand why the standard specifications in common use for tungsten lamps [1] permit the actual wattage as measured at rated voltage to be 15 to 20 per cent above or below the rated wattage in not more than 30 per cent of the lamps of a lot, and the watts-per-candle to be 8 per cent above or below the rated value in the same proportion of lamps. Then also we can understand why the test life of lamps from the same factory, made by the same employees with the same machinery, may vary so greatly from time to time that the monthly average may be as much as 25 per cent above or 25 per cent below the yearly average.[2]

Under these conditions it should be fairly apparent that at frequent intervals tests should be made, in such manner as to determine the performance of the lamps and their relative economy in production of light. The lamp manufacturers maintain testing departments, some of them very extensive and costly, to locate the faults in their own product, or the advantage which their competitors may have obtained. Some of them publish, for the benefit of the public, as much of this information as seems to them serviceable for the purposes they have in mind—namely, increase in the use of electric light by educating the public to its advantages, and increase in the consumption and sales of the lamps which they manufacture.

If the information commonly given in the advertising publications of the manufacturers were complete enough it would safeguard in fairly adequate manner the interests of the ultimate consumer of light. He would understand that the volume of lamp sales, to which the profits of the manufacturer are in some measure proportional, is dependent on the number of sockets in use, as well as on the number of lamps consumed per year per socket. He would know that for any given set of conditions, such as cost of energy per kilowatt-hour, price per lamp and number of hours burning per year, it is possible for the manufacturer to choose a certain rated voltage for each lamp, such that if that lamp be operated at that voltage the consumer will obtain a greater number of candle-hours of light for one cent or one dollar of total expenditure than he would get if that lamp were operated at any other voltage. He would know that there may exist a strong temptation for the manufacturer to rate that lamp so that it shall be operated at a higher voltage and temperature, resulting in a much earlier burn-out and the purchase of more lamps per year for that socket. If at the same time the manufacturer designs the lamp in such manner as not to reduce its voltage, but rather to give the consumer an increased candlepower as result of the higher temperature, the central station will not protest seriously, because its own sales will not be curtailed; thus one of the controls over the self-interest of the lamp manufacturer is removed, and there remains in this function only such intelligent consideration of the economic problem as the consumer himself has been educated to give.

If the consumer has been taught enough about the factors and relations involved to understand that the manufacturer *may not* be assisting him (the consumer) to produce light as cheaply as possible, this knowledge would lessen the rate of increase in the number of lamp sockets used, and thus the short-sighted policy of a manufacturer, who rated his lamp at too high voltage, would defeat its own ends. It is improbable, however, that the great majority of lamp consumers, or even of purchasing agents who buy quantities of lamps for large businesses and buildings, have sufficient education to exercise this intelligent and discriminatory control. In ordinary dealings with such customers it may be thus easily possible for the manufacturer to increase considerably his own sales and profits without antagonizing the central station, and even to the extent of raising the total cost per unit quantity of light to the consumer.

A factor, which affects this question considerably, is the recently established custom which lamp manufacturers have of rating lamps according to their wattage, rather than according to their candlepower, the latter being the old-fashioned method, which was really more intelligible and more useful to the consumer. A year ago, when the standard rated efficiency was 1.14 watts per candlepower, a certain consumer may have found it was necessary to use 25-watt lamps in his sockets, obtaining thereby about 22 candlepower per socket. Naturally associating the idea of 25 watts with those sockets, on account

1 See Circular No. 13, Bureau of Standards, Washington, D. C., entitled "Standard Specifications for Incandescent Electric Lamps."

2 See a paper on "The Problem of Incandescent-Lamp Testing" by Millar and Lewinson, in *Proceedings of the Association of Railway Electrical Engineers*, October, 1913.

of the wattage method of rating lamps, he installs new 25-watt lamps today and obtains perhaps as much as 26.3 candlepower at the latest limiting efficiency of 0.95 watts per candlepower for such lamps. This change is of little consequence to the central station as long as the consumer continues to use 25 watts per socket and not less. It is of great advantage to the manufacturer, because thereby he sells more lamps per socket per year than if he had maintained the old efficiency, and the price of a smaller size of lamp would be the same as that of the 25-watt lamp. The change is also of great importance to the consumer, because he is being unconsciously trained to use and require 26.3 candlepower in each place where 22 candlepower had been found to be sufficient (an increase of 12 per cent), and the chances are that he will never permit the light to be reduced again to the 22 candlepower which was ample before it became unsatisfactory through his being accustomed to a superfluity. Meanwhile the total annual cost of lamps is considerably increased, because the manufacturer does not and cannot reduce the unit price in proportion to the reduction of life, due to the higher efficiency, while the wattage remains approximately the same, so that the actual energy cost is not reduced.

This state of affairs would not long persist if the custom were to rate lamps in terms of candlepower or lumens instead of watts. Then, under ordinary conditions, the lamp manufacturer could not raise efficiencies without correspondingly reducing wattages. This would involve an impairment of the revenue of the central station; and the resulting forceful injection of this intelligent but contrary self-interest would result in controversy, which would certainly be better for the interests of the ultimate consumer than no controversy at all.

On these considerations it may perhaps be granted that the ultimate consumer of light should educate himself concerning the economics of light production, or should have himself advised by competent engineers, who have such education, and who are not partisans of either the central station or the lamp manufacturer. The consumer has slight reason to expect from either the energy purveyor or the lamp manufacturer enough complete information to enable him to buy the cheapest light under all conditions of energy rates, of lamp prices, and of quality of electric service (such as voltage regulation of the circuit). There may be a truce between the opposed selling interests, or there may be some skeleton to hide, such as insufficient copper in the circuits or wrong adjustment of rates, excessive life, excessive price, or excessive efficiency in the lamps. Regardless of any particular business interests or conveniences, however, the interests of the ultimate consumer remain always the same—namely, to get the greatest possible number of candle-hours of light for each dollar of total expenditure for light.

Such knowledge as the lamp consumer should have or have access to, in order to safeguard this fundamental interest in the cost of light, must be based upon accurate and painstaking tests to determine the performance characteristics of the lamp. Such tests are certainly expensive[3], although, as we shall see from the data here presented, the cost of good tests is not as great as the loss which might result even from relatively small purchases of poorly made or poorly rated lamps, such as might be selected without recourse to tests. From the viewpoint of the light consumer, such tests should be designed and presented in such a way as to exhibit clearly the total cost of a given quantity of light, and

(*a*) To distinguish the better quality and more economical lamps from the poorer quality or less economical lamp.

(*b*) To determine whether even a good lamp is rated properly in the interests of the consumer, when used under such conditions as he can provide.

If for a given quantity of light delivered (expressed in candle-hours, or candlepower times hours) the cost of lamp renewals is much higher with one brand of lamp than with another, this does not necessarily mean a correspondingly greater total cost of light, if the efficiency is also higher and the cost of energy sufficiently lower. But if the cost of renewals is higher *without* a correspondingly higher efficiency and lower cost of energy, we may reasonably conclude that the lamps are of poorer quality, the more numerous failures being due to some defect and not to higher temperature of filament.

Perhaps we should state, in justice to the lamp manufacturer, that it is practically impossible for him to "rate" or select the operating voltage for *any* lamp in such manner that it will produce light most economically for all consumers. For any given price per lamp, the least cost of a given number of candle-hours will be obtained when the lamp is operated at an efficiency which is quite definitely ascertainable for any given rate per kilowatt-hour, and which is higher for a greater price per kilowatt-hour. This is simply another way of stating that when energy is expensive it pays to economize on energy, even at the sacrifice of greater expenditure for lamps, up to but not beyond the point where the cost of lamp renewals increases faster than the cost of energy decreases, at which point the total cost of the given quantity of light reaches a minimum.

The proper temperature or the proper voltage at which a given lamp should be operated in order to give the most economical light production, is, therefore, different for each class of consumers, each locality, each size of installation; it is higher as the average price of a kilowatt-hour becomes greater or as the average net price of lamps becomes less, due either to economies in manufacture or to larger purchases resulting in greater discounts.

Under ordinary conditions of sale the best that the manufacturer can do toward achieving the most economical light production for the consumer is to select the voltage for each lamp (or the watts per candlepower or efficiency) with regard to the average energy cost per kilowatt-hour for the average consumer. It then devolves upon the engineering staff of the manufacturer, or of each central station, or upon an independent engineer to be selected by the consumer, to advise the latter what rated voltage of lamps he should use upon any particular circuit whose voltage has been ascertained. After the lamp voltages or rated efficiencies have been thus chosen in accordance with the average cost of a kilowatt-hour, it would seem that no increases of efficiency are justifiable unless the net price per lamp be reduced, so as to compensate exactly the decreased life of the lamp, or unless the materials or the processes involved in the manufacture of lamps be so improved that the average life is not reduced by the increases of efficiency.

With good quality in the lamp, therefore, good rating means further the selection of a voltage mark on the label of each lamp, such as to produce for the average consumer a definite *quantity of light* for the *least total cost.* Selection of the proper lamp for conditions which differ from the average is a task for which the consumer himself, rather than the central station or the lamp manufacturer, may justly be expected to take the responsibility. Such selection cannot be made without basis of test, and both the tests and the interpretation of them should be made by people of proper experience.

3 The tests reported in this article were made in the laboratories of the Electrical Engineering Department of the University of Michigan, Ann Arbor, Mich. Such tests are also made by the Bureau of Standards, Washington, D. C., and the Electrical Testing Laboratories, New York City. The cost varies between $3.50 and $5.00 per lamp, depending on size of lamp and completeness of the test.

The conditions under which the tests are made should receive careful consideration. There is, naturally, a desire to make the conditions as practical as possible—as near as possible to the actual average operating conditions of the lamps. Thus, inasmuch as the rated voltage marked on the label of a lamp is about the only information that the ordinary consumer has besides the wattage and the name of the brand or of the manufacturer, we should desire to test lamps at their rated voltage. Furthermore, we should desire to test them on a commercial circuit or one whose voltage varies as on a commercial circuit, because if the ordinary voltage fluctuations commonly encountered on lighting circuits have any effect upon the economy of light production, we desire that our tests and our calculations therefrom take cognizance of such effect. Such test conditions might be entirely proper if we desired merely to make a competitive and simultaneous test of a number of lamps to determine which of these particular samples is best. But if we desire to compare these tests with others made at some past or future time, or in some distant place, when the voltages are chosen on the basis of a different efficiency or when the testing voltage fluctuates in a different manner, we should find ourselves seriously embarrassed. It has, therefore, been the established practice of manufacturers' and central stations' lamp-testing departments to test lamps at a definite rated watts-per-candle, or specific consumption (reciprocal of efficiency), and at a pressure which is held as nearly constant and unvarying as is physically possible to maintain.

While the results of tests made under such laboratory conditions are most valuable to the manufacturer in enabling him to maintain a consistent quality of products, and also most valuable to the consumer when his greatest object is likewise to determine how the quality is maintained or improved, the fact remains that in a purely competitive test, to compare the relative economy of various lamps, the most interesting and significant results will be obtained when the lamps are tested at their *rated voltage* on a *commercial circuit*. Even good lamps which have been rated carelessly or erratically will then show correspondingly erratic economic performances, such as the consumer desires to know about. Furthermore, lamps whose efficiences have been pushed to the highest point that the manufacturer can conscientiously bolster up with laboratory tests, regardless of the imperfect operating conditions on the average commercial circuit, may find themselves fairly outstripped when so matched under practical conditions with other lamps which have been more conservatively rated, even at some sacrifice to the manufacturer.

The tests reported in the accompanying tables represent a public service recently performed in the laboratories of the Electrical Engineering Department of the University of Michigan, under the direction of the author of this article. They were undertaken without special compensation, to answer a question propounded by a committee of purchasing agents of institutions supported by the state, which question had been asked several times previously at intervals by the purchasing agent of the University, and answered on the basis of similar tests. The question is very pertinent and comprehensive: "Which one of this variety of brands of tungsten lamps which are offered for sale by contract, is it best for us to buy?" This quickly reduces to: "Which of this number of samples delivers the greatest number of candle-hours of light for one cent or one dollar of total expenditure?" And "Which of these samples promise the most careful and conscientious rating in future deliveries?" Of course, we may leave the matter of quality maintenance in future deliveries to be determined by periodical tests during the life of the contract, but this method is considerably more expensive and probably not much more reliable than judging it from tests made before signing a contract.

Obviously, the selection of samples is a very important matter, as each represents a large number of lamps. Methods of sampling are prescribed in all standard specifications for lamps. For the purposes of this test 24 lamps of each of the brands to be tested were purchased through diverse people in the ordinary course of business. Upon these lamps readings were taken by a special experienced observer, using calibrated apparatus of precision type, to determine the amperes and watts input to each lamp and its mean horizontal candlepower while being operated at exactly rated voltage. From these data the watts-per-candle values of specific consumption were calculated. The results are exhibited as Table I, wherein each brand or batch of samples is represented by a group letter (as F, X, etc.). In this and most of the following tables, the groups are arranged in the order of the average initial watts-per-candle for the original 24 sample lamps, the highest-efficiency lamp first and the lowest-efficiency last. It should be noted that group X was furnished gratis, and with knowledge of our purpose, by the same manufacturer from whom we purchased group W; also that group I contained only eight lamps, and was furnished, for special test, by the same manufacturer from whom we had purchased group H.

The significance of these initial tests for uniformity of rating, made upon 272 lamps and summarized in Table I, will be clearer if we note that the standard specifications for tungsten lamps give the rated initial watts-per-candle, as 1.05 (after October 1, 1914), and prescribe that not more than 30 per cent of the standard test quantity of samples may be below a limiting value of 0.95 watt per candlepower.

TABLE I.—INITIAL TESTS FOR UNIFORMITY OF RATING.

	Candlepower.			Watts.			Watts per Candle.		
Group.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
F	26.60	24.51	25.81	24.86	23.76	24.58	1.00	0.91	0.952
X	23.72	21.51	22.56	24.75	23.65	24.13	1.12	1.03	1.069
*I	22.55	21.70	22.20	24.20	24.10	24.19	1.073	1.115	1.090
C	23.78	15.30	21.61	25.20	22.00	23.65	1.44	1.00	1.099
B	22.41	18.29	20.28	24.86	22.61	23.40	1.28	1.03	1.158
E	21.15	19.46	20.39	24.20	23.65	23.91	1.29	1.10	1.170
W	21.13	17.86	19.59	25.08	23.61	24.59	1.35	1.16	1.257
N	21.77	17.58	20.05	27.00	25.28	26.25	1.44	1.21	1.308
H	21.75	14.10	18.73	28.60	23.60	24.96	1.68	1.16	1.347
K	18.00	16.37	17.28	25.08	24.29	24.82	1.48	1.38	1.436
U	24.61	17.73	22.76	35.86	22.10	33.33	1.62	1.22	1.461
V	21.20	13.59	17.42	26.73	24.86	25.99	1.88	1.17	1.503

Figures represent averages for 24 lamps of each group, except (*), of which there were 8.

TABLE II.—INITIAL TESTS FOR UNIFORMITY OF RATING.

	Variation in Per Cent of Average Value.			Variation in Per Cent of Rated Value.		Average Watts in Per Cent of Rated Watts.	Watts per Candle, Average.
Group.	Candlepower.	Watts.	Watts per Candle.	Watts.	**Watts per Candle.		
F	8.1	4.5	9.4	4.4	8.6	98.4	0.952
X	9.8	4.6	8.4	4.4	8.6	96.6	1.069
*I	3.8	0.4	3.9	0.4	4.0	96.7	1.090
C	39.2	13.5	40.0	12.8	41.9	94.7	1.099
B	20.3	9.6	21.6	9.0	23.8	93.7	1.158
E	8.2	2.3	16.2	2.2	18.1	95.7	1.170
W	16.7	6.0	14.9	5.9	18.1	98.4	1.257
N	20.9	6.5	17.6	6.9	21.9	105.0	1.308
H	40.8	20.0	38.6	20.0	49.5	99.9	1.347
K	9.4	3.2	7.0	3.2	9.5	99.3	1.436
U	30.2	41.3	27.4	55.0	38.1	133.2	1.461
V	43.6	7.2	47.2	7.5	6.8	104.0	1.503

Notes: *Each group represented in this table contained 24 lamps, except *I, which contained only 8.

**The rated value here referred to, namely 1.05 watts per candle, has been in force since October 1, 1914. If any lamps in this test be considered to have been manufactured and placed in stock before October 1, 1914, multiply these figures by 0.92.

TABLE III.—RANGE OF LAMPS REPRESENTED IN LIFE TEST.

	Lamp consuming least number of watt-hours per candle-hour, in the group.							Lamp consuming greatest number of watt-hours per candle-hour, in the group.					
	Serial Number of	Initial Values.			Last Readings.			Initial Values.			Last Readings.		Serial Number of
Group.	Lamp.	Watts.	Candle-power.	Watts per Candle.	Watts.	Candle-power.	Watts per Candle.	Watts.	Candle-power.	Watts per Candle.	Watts.	Candle-power.	Watts per Candle.	Lamp.
F	197	24.20	26.60	0.910	23.68	†26.80	0.884	23.76	25.87	0.919	21.75	20.35	1.071	209
X	241	23.76	22.00	1.08	23.70	†23.90	0.99	24.20	21.51	1.12	23.10	18.90	1.22	251
*I	604	24.20	22.37	1.083	23.00	20.52	1.12	24.20	21.70	1.115	21.67	17.66	1.23	610
C	19	23.63	23.54	1.004	....	†	....	22.00	15.30	1.44	19.76	13.40	1.48	24
B	110	23.93	22.37	1.07	21.45	18.95	1.13	24.14	20.54	1.17	19.80	12.74	1.55	108
E	170	23.76	19.46	1.22	24.55	†23.88	1.03	23.65	21.03	1.12	23.20	†22.78	1.02	177
W	236	24.63	20.56	1.20	24.80	†23.45	1.06	24.63	19.59	1.26	21.50	15.85	1.35	237
N	129	26.40	20.46	1.29	25.40	†23.70	1.07	25.28	17.58	1.44	23.00	16.95	1.36	140
H	46	23.62	14.10	1.68	24.75	†22.88	1.08	23.62	15.14	1.57	23.20	†16.75	1.38	26
K	148	24.80	17.39	1.43	24.65	†18.37	1.34	25.08	17.60	1.43	24.50	16.28	1.50	152
U	64	27.94	22.95	1.22	28.74	†28.50	1.01	35.10	22.55	1.56	33.85	†25.65	1.32	52
V	73	25.30	16.91	1.50	25.10	†26.13	0.96	26.73	16.79	1.59	24.90	†21.18	1.18	75

Notes: All values given in this table were measured at rated voltage of the lamp. These are not the lamps having the lowest and the highest initial efficiencies in each group, but those having the *lowest and highest average operating efficiencies.*
†Indicates that the filament of the lamp had short-circuited sometime before the last reading.

These figures, as well as all the test data here reported, refer to lamps of the 25-watt size. The specific consumption of a large proportion of the sample lamps was so high as to lead to the conclusion that they might have been manufactured and placed in stock before the new and higher efficiencies went into effect, which was October 1, 1914. However, as the rated efficiency before this date was 1.14 watts per candlepower, we see that in the case of many of the groups not only the permitted 30 per cent but practically *all* of the test lamps and the average of the whole group exceeded the rated and allowable value of watts per candlepower. It is to be noted also, from Table I, that the manufacturer is much more skillful or conscientious in keeping close to the rated wattage of the lamps than in keeping close to their rated watts-per-candle. This may be due to the fact that wattage may be more easily and more accurately measured than candlepower, or it may be due to the fact that the ordinary lamp consumer is more careless and easier to get along with than the central station.

Perhaps it were well to mention at this point the matter of breakage. Just one-third of the K group of samples (8 lamps), were broken in handling before any reading could be taken on them—filaments either found broken in the original cartons, or broken in course of ordinary handling preparatory to test. This might indicate careless handling were it not for the fact that six groups (C, B, E, F, W. X.), weathered exactly the same handling without any breakage among the 24 samples, and four groups (H, U, V. N), showed only one breakage out of each 24 samples.

In Table II we have reduced to a percentage basis the data of Table I. To understand the full significance of this table we should note that the standard specifications permit not more than 30 per cent of the standard sample quantity to be more than 15 per cent above or below rated wattage, or more than 8 per cent above or below rated watts-per-candle. To be sure, these particular samples were not selected in the exact manner prescribed for standard samples—but they *were* selected more nearly as the the ordinary consumer would make purchases. Notice from Table II that in several groups (C, B, E, W, N, H, U) these standard limits for watts-per-candle are exceeded, while in only one group (U) are the wattage limits exceeded. Notice also that one group (K), which was of such poor quality that one-third of all the filaments were broken before test could be made, and which will subsequently appear to have presented a very poor economic performance, actually proved to be one of the most uniformly rated groups. In this there is a caution not to judge too much concerning the quality of a lamp from the uniformity of its ratings.

TABLE IV.—PRESSURE RECORD.

Actual Hours Burning. Interval.	Total.	Average Voltage During Interval.
53.	53.	107.8
48.	101.	108.0
51.5	152.5	108.0
20.	172.5	110.0
24.	196.5	110.0
70.	266.5	110.0
66.	332.5	109.4
51.	383.5	109.4
78.	461.5	109.4
46.	507.5	109.2
48.	555.5	110.0
76.	631.5	110.8
85.	716.5	111.25
102.5	819.	112.15
96.	915.	113.0
97.	1012.	114.16
92.	1104.	114.65
115.	1219.	116.44
95.	1314.	116.8
90.5	1404.5	119.22
97.	1501.5	119.
97.	1598.5	119.85
91.	1689.5	120.2
112.	1801.5	119.66
120.	1920.5	119.5
123.	2043.5	119.5

We are now up to the life test. From each group of 24 samples, nine were selected to be operated continuously at or near rated voltage until they should fail. These nine included the three having the highest values of watts-per-candle, the three having lowest values of watts-per-candle and the three whose watts-per-candle values were nearest to the average for the entire group of 24. At intervals of from 24 to 50 hours at the beginning, and of 70 to 120 hours near the end of the tests, each lamp was taken out of the life-test rack (where it had been burning in a vertical position), was placed in the rotator and measured for mean horizontal candlepower and for amperes consumption at exactly rated voltage.

Table III is arranged to show the range of operating efficiency for the lamps participating in this life test. In this and succeeding tables the *operating efficiency* is taken to mean the total watt-hours consumed divided by the total candle-hours delivered during the entire life of the lamp, and not merely the initial watts-per-candle as measured at a given moment. On acount of the voltage variations on the circuit there is in some cases a considerable difference between these two efficiency values for the same lamp, particularly in the case of those which weathered the high-voltage periods encountered near the end of the test. (See Table IV.) The "last readings" in Table III refer to those just preceding destruction of the lamp, as all lamps were tested to complete failure of the filament. The lamp may have burned quite a few hours after this "last reading."

Several facts are worth noting from Table III. The most significant is that practically all of the lamps having highest operating efficiency, or highest initial watts-per-candle, had their filaments broken and welded (sometimes on several ocasions and in different places) before they finally failed, while most of the low-efficiency lamps jogged along without breakage until the filaments burned through, at which time they were beyond resuscitation. In computing the economic performance of the lamps this short-circuiting action was not considered to terminate the useful life of the lamp, but the candle-hours and watt-hours continued to count until the lamp absolutely refused to work, as this was considered to be the treatment it would receive from the ordinary consumer. The short-circuiting of these high-efficiency lamps was not due to carelessness, because frequently it would happen while nobody was near the lamp, and because all lamps were treated exactly alike.

As long as the life test was in progress, a permanent record was made by a calibrated curve-drawing

TABLE V.—LIFE TEST TO DESTRUCTION.

Group.	Watts per Candle. Initial Average.	Watt-hours per Candle-hour, Average.	Light Output—Average Total Candle-hours per Lamp.	Energy Input—Average Total Watt-hours per Lamp.	Total Life, in Hours. Actual, as Tested. Maximum.	Minimum.	Average.	Reduced to Rated Volts. Maximum.	Minimum.	Average.
F	0.951	1.032	14,774	15,242	757	621	688	750	601	673
X	1.069	1.106	18,958	20,973	1,269	376	940	1,653	341	1,069
*I	1.090	1.060	19,597	20,765	990	703	863	1,647	908	1,302
C	1.128	1.127	16,309	18,390	2,047	151	872	4,071	115	1,129
B	1.161	1.173	21,202	24,870	1,634	907	1,148	2,778	962	1,466
E	1.180	1.116	28,910	32,263	1,695	923	1,431	2,963	984	2,166
W	1.254	1.145	22,716	26,020	1,605	366	1,136	2,850	330	1,552
N	1.311	1.161	6,014	6,982	819	56	361	837	46	358
H	1.386	1.238	11,603	14,367	975	99	643	1,075	81	659
K	1.436	1.320	14,097	18,603	1,600	53	794	2,657	43	951
U	1.419	1.216	11,637	14,153	819	223	477	837	188	450
V	1.524	1.200	20,367	24,446	1,560	828	1,061	2,503	850	1,288

Notes: Each group contained 9 lamps except *I, which contained only 8.
All lamps were tested on a commercial circuit (varying voltage), alternating current.
Average initial watts per candle applies only to lamps in the life test.

voltmeter. At suitable intervals the voltage was averaged. (See Table IV.) From this average expressed as a percentage of the rated voltage of the lamps, from the candlepower and wattage of the lamp, as measured at rated voltage, during the interval, and from the published curves and formulas exhibiting relationship between watts or candlepower and volts, as developed by average experience, the total watt-hours of electrical energy consumed and the total candle-hours of light delivered by each lamp during each interval was calculated. These values were integrated over successive intervals, and thereby the values of total watt-hours and total candle-hours for the entire life of each individual lamp were obtained. The total watt-hours or candle-hours for all the lamps of a group, divided by the number of lamps in the group, yielded the average values of total energy input and total light output which appear in Table V. From the actual total life, as measured under the test conditions, the probable life at rated voltage was estimated by following the method outlined above, using the relations between life and voltage, as given in the "American Handbook for Electrical Engineers," published in October, 1914.

From Table V note that in general the lamps operating at the lower efficiences or higher watts-per-candle are those which have the longer life, and deliver the greater output of candle-hours. This seems to be true as we go down the list until we get to the N brand. Note that although the N, H, K and U brands operated at comparatively low efficiencies (high values of watt-hours per candle-hour), their average life was short. This may be taken as conclusive evidence of inferior quality in these lamps. Group V seems to be better than N, H, K or U, although it is clearly not in the same class with the first seven groups, because its fairly long life is obtained at a considerable sacrifice of efficiency.

The maximum and minimum life values given in Table V are interesting, particularly when considered in the light of Table IV, from which we may see in many cases the particular voltage conditions under which the lamps failed. Note that in group K, which exhibited great uniformity of rating, we find the shortest life of all, as well as one of the longest lives. Note also that the short average life of group F cannot be excused on the basis of protracted period of abnormally high voltage, because Table IV shows that up to the time when the last lamp of group F failed the average voltage had not exceeded 112. In fact, detailed examination of the record covering burn-outs in group F shows a peak voltage of 117, which persisted for less than two hours. It is fairly evident, therefore, that the greater responsibility for the short average life of group F rests upon the manufacturer, who had pushed his efficiencies up to the very limit permitted by the standard specifications.

In Table VII are presented the economic values for the various group averages. To obtain the figure of total candle-hours for one cent expenditure, we divide total candle-hours output of lamp by total money expended. In these calculations we have assumed that the total cost consists of only two items—cost of lamp renewals and cost of energy consumed. Certainly these two are the largest items of cost, beside which all other items are insignificant. It is the common practice of lamp manufacturers to consider only these two items of cost in their publications concerning economic performance of lamps. It may be argued that we have neglected to consider the fixed costs, such as interest and depreciation, labor or cleaning; or the variation of charges for accidental breakage or stealing of lamps, due to change of life; or the decrease of obsolescence charge against each lamp as the average life is lowered. Even where the propriety of such charges is not open to serious dispute, their value is either indeterminate or insignificant.

The total cost of energy for a lamp depends directly upon the average cost of one kilowatt-hour, and this unit cost varies widely with conditions. A value of 11 cents has been assumed to be about the highest ordinarily encountered, even for residential lighting. A value of 3 cents has been assumed to be about the lowest enjoyed by any consumer, even an isolated plant where the exhaust steam is a useful by-product. A value of 7 cents has been assumed as a probable

TABLE VI.—RANGE OF ECONOMIC VALUES IN EACH GROUP OF LAMPS.

	Performance of Lamp Operating at Highest Average Efficiency in the Group.					Candle-hours for One Cent with Energy at Rate of 3 Cents per kilowatt-hour.	Candle-hours for One Cent with Energy at Rate of 11 Cents per kilowatt-hour.	Performance of Lamp Operating at Lowest Average Efficiency in the Group.				Candle-hours for 1 Cent with Energy at Rate of 3 Cents per Kilowatt-hour.	Candle-hours for 1 Cent with Energy at Rate of 11 Cents per Kilowatt-hour.	Variation of Candle-hours for One Cent, in per cent of Average for Group.	
Group.	Lamp Number.	Candle-hours.	Watt-hours.	Watt-hours per Candle-hour.	Initial Watts per Candle.			Candle-hours.	Watt-hours.	Watt-hours per Candle-hour.	Initial Watts per Candle.			Lamp Number.	Energy at 3-cent Rate.	Energy at 11-cent Rate.
F	197	15722	15371	0.977	0.910	235.3	82.9	15128	16410	1.085	0.919	216.4	75.2	209	8.5	9.8
X	241	8767	8746	0.997	1.08	186.8	75.0	21465	25121	1.171	1.12	223.4	72.3	251	16.1	3.6
*I	604	16481	17136	1.040	1.083	232.4	79.2	21964	23873	1.087	1.115	241.0	77.8	610	3.6	1.8
C	19	2720	2118	0.778	1.00	100.4	61.8	35367	44671	1.264	1.44	228.6	69.0	24	59.6	9.8
B	110	21637	23077	1.065	1.07	240.8	78.8	26773	35100	1.312	1.17	212.3	65.8	108	12.8	18.1
E	170	16662	17957	1.077	1.22	223.3	76.4	24455	27728	1.135	1.12	235.4	75.1	177	4.9	1.7
W	236	8477	8822	1.040	1.20	179.5	72.0	32094	37780	1.176	1.26	239.5	73.4	237	26.1	1.9
N	129	2277	2487	1.092	1.29	84.3	48.5	14821	17915	1.210	1.44	202.4	68.4	140	79.4	31.8
H	46	16725	19035	1.139	1.68	218.3	73.0	10733	14783	1.378	1.57	168.2	58.9	26	27.0	21.6
K	148	16512	20810	1.260	1.43	205.3	66.9	15270	21212	1.390	1.43	187.0	60.7	152	9.6	9.8
U	64	5009	5313	1.060	1.22	141.5	64.3	6231	8272	1.327	1.56	140.6	56.4	52	0.5	11.9
V	73	15272	21046	1.152	1.50	221.2	72.8	16237	19328	1.264	1.59	209.5	70.0	75	5.3	4.0

TABLE VII.—ECONOMIC RESULTS OF LIFE TEST.

Group.	Net Price of One Lamp (cents).	Total Cost of Energy during actual life as tested, with average rate per kilowatt-hour 3 cents.	7 cents.	11 cents.	Candle-hours for one cent, with energy at average rate of 3 cents.	7 cents.	11 cents.
F	20.7	45.7	106.7	167.7	222.5	116.0	78.4
X	20.7	62.9	146.8	230.7	226.8	113.2	75.5
*I	19.5	62.3	145.4	228.4	239.5	118.9	79.0
C	20.7	55.2	128.7	202.3	215.0	109.2	73.1
B	20.7	74.6	174.1	273.6	222.5	108.8	72.0
E	20.7	96.8	225.8	354.9	246.0	117.2	77.0
W	20.7	78.1	182.1	286.2	230.0	112.0	74.0
N	19.5	20.9	48.9	76.8	148.8	88.0	62.5
H	19.5	43.1	100.6	158.0	185.4	96.7	65.4
K	18.0	55.8	130.2	204.6	191.0	95.1	63.3
U	19.5	42.5	99.1	155.7	187.7	98.2	66.4
V	19.5	73.3	171.1	268.9	219.6	106.9	70.6

weighted average for all classes and sizes of consumers. The unit price of lamps is from quotations based on a contract for $5,000 worth of lamps per year, this being the amount estimated to be required by the purchasing agents for whom this test was made.

Notice in Table VII that when energy costs 3 cents per unit the lamp having the highest economic value (246 candle-hours for one cent) is not the lamp which operated at highest efficiency, but is the lamp which gave the largest life with reasonable efficiency. When energy costs 11 cents per unit the most economical lamp (group F, 78.4 candle-hours for one cent) is the one which operates at the highest efficiency here represented. As the cost of energy becomes less the economic leadership of the longest-life group (E) becomes greater, and as the cost of energy becomes greater the economic leadership of the highest efficiency group (F) becomes more pronounced. For the average energy price of 7 cents, the greatest economic value pertains to group E, which had an average initial efficiency of 1.180 watts-per-candle and an average operating efficiency of 1.116 watts-per-candle during the life test. If curves be drawn from these economic performance data, it becomes clearly evident that:

(*a*) There is a fairly definite watts-per-candle value at which the number of candle-hours obtained for one cent is a maximum.

(*b*) This value of watts-per-candle becomes less as the unit cost of energy increases.

(c) For an average unit cost of 7 cents for energy, lamps should be chosen or rated so as to operate at about 1.12 to 1.05 watts-per-candle. For an average unit cost of 3 cents for energy, lamps should be chosen or rated so as to operate at about 1.12 to 1.15 watts-per-candle. In any event, a specific consumption as low as 0.95 watts-per-candle seems to be unjustifiable from the viewpoint of the consumer, except in cases where the highest rates are paid for electrical energy.

Caution should be observed in basing generalizations upon these results, or upon the results of any other single test of a limited number of lamps. Only lamps of the 25-watt size participated in this test, whereas the most usual size of tungsten lamp is 40 watts. A 40-watt lamp would cost about the same as a 25-watt lamp, while its rated efficiency would be higher and its life is very likely to be longer. However, the proper rated efficiency and the limiting efficiency for the 40-watt lamp, or for any other size, should be fixed by the same considerations that are outlined above.

It is interesting to note that these economic coefficients were computed for typical individual lamps at successive stages of their lives, to determine whether there is a "smashing point" short of the actual ultimate life, at which it is cheaper to throw away an operative lamp than to retain it in service. No such point could be determined; the value of candle-hours delivered for one cent increased up to the point of failure.

It is also to be noted here that groups F, X, C, B, E and W are of the familiar Mazda brands of lamps, while groups I, N, H, K, U and V are "independents." Most of the independents here represented seem to be of such poor quality that they act as gleaners rather than as real competitors of the Mazda lamps. There are, however, evidently, at least one or two independents which are, in respect of quality and economy, real competitors of the Mazda lamps. In the estimation of the writer, the public should encourage such good independents as groups V and I, if only to serve as regulators

TABLE VIII.—EFFECTS OF FAILURE TO SELECT THE MOST ECONOMICAL LAMP.

All figures in this table are based on equal quantity of light produced, namely 1000 million candle-hours.

Distinguishing Characteristic of Lamp.	Average Rate for Energy, Cents per hour.	Brand of Lamp.	Cost, in Dollars, of Lamps.	Energy.	Total.	Loss to Consumer, by Failure to Select Most Economical Lamp. Dollars.	Per Cent of Cost of Lamps Used.	Per Cent of Total Cost by Most Economical Lamp.	Change of Sales in Comparison with Most Economical Lamp. Energy. Dollars.	Per Cent.	Lamps. Dollars.	Per Cent.
Most economical and most efficient	11	F	14020	113580	127600	....	....	....	....	....	....	....
Longest life and greatest output of light	11	E	7150	122650	129800	2200	30.8	1.7	+ 9070	+ 8.0	—6870	—49.0
Lowest-priced lamp	11	K	12780	145220	158000	30400	238.0	23.8	+31640	+21.8	—1240	— 8.8
Most economical, longest life, and greatest output of light	3	E	7150	33480	40630	....	....	....	....	....	....	....
Most efficient	3	F	14010	30940	44950	44950	30.8	10.6	—2540	— 7.6	+6860	+96.0
Lowest-priced lamp	3	K	12780	39600	52380	11750	92.0	28.9	+ 6120	+18.3	+5630	+78.7

TABLE IX.—EFFECTS OF FAILURE TO SELECT MOST ECONOMICAL LAMP.

All figures in this table are based on equal quantity of energy consumed, namely 625,000 kilowatt-hours delivered to 25,000 25-watt lamps operated for 1000 hours.

Distinguishing Characteristic of Lamp.	Average Rate for Energy, Cents per Kilowatt-hour.	Brand of Lamp.	Cost, in Dollars, of Lamps.	Energy.	Total.	Change of Cost to Consumer by Failure to Select Most Economical Lamp. Dollars.	Per Cent of Cost of Lamps Used.	Per Cent of Total Cost by Most Economical Lamp.	Amount of Light Received by Consumer, in Millions of Candle-hours.	Change of Sales of Lamps in Comparison with Most Economical Lamp. Dollars.	Per Cent.
Most economical and most efficient	11	F	8490	68750	77240	....	....	....	606	....	.....
Longest life and greatest output of light	11	E	4010	68750	72760	—4480	—111.8	—58.0	560	—4480	— 52.8
Lowest-priced lamp	11	K	6045	68750	74795	—2445	— 40.4	— 3.2	473	—2445	— 28.8
Most economical, longest life, and greatest output of light	3	E	4010	18750	22760	....	....	....	560	....	.....
Most efficient	3	F	8490	18750	27240	+4480	+ 52.8	+19.7	606	+4480	+111.8
Lowest-priced lamp	3	K	6045	18750	24795	+2035	+ 33.7	+ 8.9	473	+2035	+ 50.8

of the business or as good impulses for the powerful majority.

Although groups H and I came from the same factory their efficiencies, life performance, and economic values are entirely different. The writer believes that this is because the lamps of group I were carefully selected with knowledge that they were to be tested, while group H was purchased without such knowledge on the part of the manufacturer. The manufacturer professes that he had to use inferior tungsten wire in group H, because of interference with his regular supply on account of war. Reference to the tables shows that group I was in all respects more uniform than group H—as to rating, selection, life and economic performance. Although group H operated at much lower efficiency than group I, its average life was only half as long. Naturally, therefore, there is a tremendous difference in their economic values as exhibited in Table VII. Comparing groups W and X, which also were both from one factory, we find indications of much greater uniformity in the product. In this case a decrease of about 0.04 watt-per-candle in the averaged specific consumption caused a decrease of 33 per cent in the total average life. Of these two groups, again, the one which has the higher efficiency is at disadvantage when the rate for energy is low, and at advantage when the rate for energy is high. Table VI is given to indicate the range of economic values exhibited by each group.

Perhaps the gist of the whole matter is presented in more practical fashion in Tables VIII and IX than in any of those preceding. The natural tendency would be for the purchaser to consider that the percentage he would save or lose by choosing one lamp rather than another depended upon the list price of the lamp and the percentage discount offered. The purpose of Table VIII and IX is to show him that it bears a very remote and almost negligible relation to the unit price of lamps, and that it is likely to be enormously greater than the mere difference in percentage discounts, or the difference in net prices of lamps.

A purchaser having a fairly creditable knowledge of the subject might be expected to cast his choice among the lamps having some distinguishing characteristics, as follows:

(*a*) The most economical lamp.

(*b*) The lamp having longest life.

(*c*) The lamp having highest efficiency.

(*d*) The cheapest or lowest-priced lamp.

Although these characteristics are arranged in the order of their relative importance under ordinary conditions, it is likely that (*a*) would be the last to occur to the ordinary purchaser, and that either (*d*) or (*b*) would be the first considered.

Table VIII is founded on the most reasonably and just basis, namely, *equal quantity of light delivered in all cases.* The calculations are made on each of the extreme values assumed for the average kilowatt-hour. It appears that if energy costs about 11 cents per unit, the most economical lamp is also the most efficient (F). If instead of this we select the lamp (E), which gives longest life and greatest average number of candle-hours, and which costs exactly the same per lamp as (F), we should actually spend $2,200 more for each thousand million candle-hours consumed. This loss amounts to nearly 31 per cent of the cost of the lamps themselves, and nearly 2 per cent of the price for which the same quantity of light could be obtained through the most economical lamp. If we examine the individual interests of the central station and of the lamp manufacturer who co-operate to serve the consumer, we find that the central station increases its sales by 8.0 per cent, or $9,070, and the lamp manufacturer decreases his sales by 49 per cent, or $6,870, when the consumer purchases the lamp having the longest life, instead of the one showing the greatest economy.

If the customer were so short-sighted as to be deceived merely by a reduction of about 10 per cent in the unit price of lamps, and were to buy the lowest-priced lamp with energy at 11 cents per kilowatt-hour, Table VIII shows that the total cost of the same quantity of light would be *increased* by $30,400, which is nearly 2.5 times as great as the cost of all the lamps used, and is nearly 25 per cent of the total amount for which this amount of light might be purchased by the greatest economy. The central station would thereby benefit to the extent of an increase of $31,640, or 21.8 per cent in its energy sales, while the lamp manufacturer would sell $1,240, or 8.8 per cent *less* of lamps than he would if the most economical lamps were selected.

The reader can easily interpret for himself the remainder of Table VIII. It is significant that under no circumstances here arising is it wise to purchase the lowest-priced lamp; any customer who keeps his attention concentrated on the unit price of lamps is oblivious to losses at the coal pile which are enormously greater than any saving which can possibly be achieved by lowering the unit price of lamps.

Table IX is similar to Table VIII in form, but it illustrates the gain or loss to customer, to central station and to lamp manufacturer, due to selection of some other than the most economical lamps, when the conditions are adjusted so that an equal quantity of energy is consumed in all cases. Although this case is not as reasonable and proper as that represented in Table VIII, it is probably more commonly met under the ordinary system of rating lamps according to wattage. It is plain that if the consumer designed his wattages per socket in accordance with the rated efficiency and candlepower per lamp, as found from the bulletin of a good or a large manufacturer (E or F), and then accepted the lowest bid for lamps (K), he would decrease the total cost of service slightly (about 3.2 per cent) and he would reduce the total amount paid for lamps by about 28.8 per cent of what he would have to pay for the most economical lamps; but he would get an amount of light which would be grossly inadequate, being, in fact, only 78 per cent of what he had found to be necessary and had calculated to receive. The most economical lamp, in point of service received per unit of total cost, is still the F lamp when energy costs 11 cents per kilowatt-hour and is still the E lamp when energy is as low as 3 cents per kilowatt-hour.

American Tools and Electrical Supplies for Russia.

United States Consul General John H. Snodgrass, of Moscow, reports that American manufacturers of metal goods are much interested in the conditions of manufacture of tools most used in Russia. They are collecting information on the Russian markets, on the basis of which they will start manufacturing such articles for Russia.

It appears that American electric works are in a position to make very favorable propositions in electrical supplies, of which there is a great scarcity on the Russian market. The only difficulty consists in the size of the order, the minimum stated by the American manufacturers being so large that the Russian purchasers are unable to distribute the amount.

Virginia Coal.

The production of coal in Virginia in 1914 was 7,959,535 short tons, valued at $8,032,448. This was 868,533 tons less than in 1913, with a decline in value of $920,205, yet the output was greater than in any year previous to 1913.

The New England Power Company of Maine and the Connecticut River Power Company of Maine have been consolidated into the New England Power Company, a voluntary association capitalized at $8,370,000.

Engineers' Report on Milwaukee Street Lighting.

The firm of Vaughn, Meyer and Sweet, consulting engineers, has been making during the past year a survey for the purpose of recommending a system of street lighting for the city of Milwaukee, Wis. As a result of this study a report has been made to the City Council during the week and a summary of the recommendations made in this report is given herewith.

The report recommends as the principal unit for street lighting the gas-filled tungsten lamp, equipped with globes of the prismatic-refractor type. The type of fixture recommended is one which has been designed especially for the purpose by the engineers. Gas lamps utilizing a mantle are recommended for supplementary use where such lamps can be provided in suitable sizes.

Posts are recommended of such types as to give a mounting height of 30 feet above the street surface in the main business district and upon certain specified boulevards, 22.5 feet for business districts other than the main business district; 22.5 at the intersections of residence streets; 15 feet on certain boulevards and on long residence blocks between intersections; 45 feet at certain squares and open places, including the intersections of some of the principal streets.

Entirely new street-lighting circuits are recommended, the routing of which is specified.

It is recommended that lamps be provided with transformers with adjustable taps so that a lamp failure will not interrupt the circuit and no constant-current regulator will be required. Self-winding time switches are recommended for turning current on and off, these to be located at the points where feeder circuits connect to the street-lighting circuits.

The system recommended provides that approximately 8,500 lamps be installed within the next 2.5 years. For the latter installation of additional lamps recommendations are made as to locations and order.

Renewal of electric lamps is recommended not only when burnt out, but when the light drops to 80 per cent of the initial value. In the case of gas lamps the light emitted should not drop below 70 per cent of the initial value, such initial value being 10 per cent higher than that of the equivalent electric lamp. Cleaning at least once a month is recommended and also painting of the posts every two years. Except for mounting heights of 45 feet, it is recommended that an extensible platform wagon be used for renewal and maintenance work. For the lamps mounted 45 feet above the ground provisions should be made for lowering the lamp.

Ownership of the system by the city is recommended. If immediate ownership is not adopted, the contract should provide for title by the city at the end of the contract period. Installation of the system should begin at once and be carried to completion as soon as funds will permit. The installation should be complete before the end of 1917. Where new paving is under way in streets, underground circuits should be laid at once. The new system should be put in operation first of all in districts where present street lighting is especially inadequate, notably in the northwest and southwest portions of the city. The maintenance of the system should be provided for by the city in the case of the electric equipment. For the gas lamps, maintenance by the utility company, providing service is recommended, with adequate inspection by the city.

To carry out these recommendations a division of street lighting should be created as part of the Department of Public Works for supervision and inspection, but the actual work of maintenance should be performed by the Police and Fire Alarm Department. Purchase of the electrical energy on a kilowatt-hour basis is recommended, with a contractual provision for the continued operation of existing street lamps until these are superseded. A contract period of five years is suggested.

Control and regulation of street lighting by private individuals through legislative enactment is recommended.

It is stated that the system recommended will give a greatly improved street-lighting service at a cost only slightly greater than that of Milwaukee's present system, but a cost below the average of other cities of the same size.

Progress in Artificial Lighting.

At the meeting of the Chicago Section, Illuminating Engineering Society, on the evening of June 22, an address was given by Edward L. Nichols, professor of physics in Cornell University, on "Artificial Lighting in 1900 and 1915."

Professor Nichols pointed out three main epochs in the development of artificial lighting. One of these was the introduction of illuminating gas; the second the introduction of electric illuminates; and the third the substitution for these and all other forms of illumination by incandescent carbon, of substances other than carbon, which in the main give selective emission. These include mantel gas burners; flame magnetite and mercury arc; tungsten filaments; and electric vacuum tubes. This last epoch resulted in an advance in the case of both gas and electric lighting of about 10 to 1 over the use of carbon. He advocated the entire replacement of illuminating gas by fuel gas, so that the use of gas mantels would become essential. He also pointed out the gain that would result in burning gas for power-generating purposes in place of coal. This would combine higher efficiency of utilization with a smokeless condition of our cities.

Artificial daylight was considered by the speaker, who pointed that it was desirable for certain industrial and commercial purposes, but not for general illumination. Lantern slides were utilized to show the contrast between artificial daylight, candle light, and the unchanged light from an electric arc. The effect of colored light upon colored objects was well illustrated by the use of lantern slides made by the three-color process. He considered the most important element in the proper application of artificial lighting to be in the esthetic training of those responsible for such installation.

The paper was discussed by J. R. Cravath, Douglass E. Wood, M. G. Lloyd, F. A. Vaughn, J. B. Jackson, A. W. E. Hooper and Albert Scheible.

Mr. Cravath referred to the necessity of shielding the eye from the excessive brightness of modern light sources and spoke of the proposed use of the name "lambert" for a new unit of brightness which is defined as that of a surface which emits one lumen per square centimeter in comformity to Lambert's law. Mr. Wood stated that there is a demand for lighting units giving artificial daylight for certain particular purposes, but not for general use. Even stores, which need such units for proper matching of goods, do not seem to realize the necessity for them. Mr. Vaughn told of an installation made to permit correct matching of black hosiery. Mr. Jackson told of the necessity of excluding daylight from the new office building of the Commonwealth Edison Company through the former skylight, owing to the fact that the artificial illumination has been designed to give an amber tint.

Dr. Lloyd reported on work which had been accomplished towards having instruction in proper lighting introduced in the public schools. Addresses have been given by Messrs. Durgin and Cravath at the Flower Technical High School, which were very much appreciated. A motion was passed for the appointment of a committee to recommend a plan for carrying on a much needed education of the public in the matter of correct lighting.

Texas Coal Output.

The amount of coal produced in Texas in 1914 was 2,323,773 short tons, valued at the mines at $3,922,459.

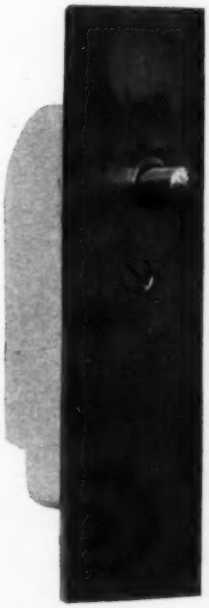
The coal production of the state is nearly evenly divided between lignite and bituminous coal.

New Electrical and Mechanical Appliances

Automatic Door Switch.

The automatic door switch, known as type GE-273, is installed flush with the door jamb to control lights in cellars, closets, refrigerators and rooms where lights must be turned on and off very frequently or where lights are liable to be forgotten and left burning when not required.

Two forms are manufactured by the General Electric Company. The mechanism of one is so designed that the circuit is closed when the door is opened, and the other type operates so as to close the circuit when the door is closed. Both are single-pole



Automatic Door Switch.

and are rated at 3 amperes, 250 volts and 6 amperes 125 volts.

Metal door-switch boxes are furnished by various manufacturers to accommodate this switch.

Hotpoint Electric Ovenette.

The approach of the summer season emphasizes the value of electric cooking, on account of its great convenience and comfort. Since summer cooking involves the preparation of relatively light meals, this calls for liberal use of convenient electrical appliances, especially such as can be used on the dining-room table and connected directly to the lighting circuit.

To still further increase its variety of electric heating devices, particularly along the line suggested above, the Hotpoint Electric Heating Company, Ontario, Cal., has placed on the market a device known as the Hotpoint Ovenette. Strictly speaking, this is not an electrical appliance itself, because it contains no heating element. However, it is a very convenient auxiliary to the electric disk stove, especially those made by the company, and known as El Glostovo, which is of the glowing-coil type, and El Grilstovo, a combination disk stove and grill, which was described in our issue of April 17, 1915.

The ovenette is made of pressed steel heavily nickeled and highly polished. It is used by placing it directly over the glowing coils of either of the stoves mentioned, being entirely sealed when

Ovenette and Grill Stove.

closed to form an efficient chamber for baking and roasting. It is said that a pie or pan of biscuits can be baked in ten minutes in this manner. It will also roast meats, fowl and other food, and anything that can be contained within its capacity. The illustration herewith shows the ovenette ready to be placed upon the appliance known as El Grilstovo.

A New Commutating-Pole Direct-Current Motor.

The use of commutating poles has given impetus to the further extension of uses for direct-current motors in service where severe sparking formerly was a serious limitation. A new type of motor making use of commutating poles has recently been placed on the market by the Eck Dynamo & Motor Company, Belleville, N. J. This machine embodies many features of the most advanced design, for which reason the manufacturer has termed it the "High-Grade" motor.

The commutating poles are placed midway between the main field poles and carry the full armature current. In number they correspond to the number of main poles. The main field poles, as well as the commutating poles, are made of laminated steel assembled under pressure and then firmly riveted together. The poles are provided with ventilating spaces, through which the current of cool air supplied by the self-ventilating fan passes freely.

At the pulley end of the armature, opposite the commutator end, there is provided a series of vanes, which give positive ventilation, which results in low temperature rise while operating even under full load continuously. The armature is provided with self-alining and double-row ball bearings, which re-

Eck Commutating-Pole Motor.

duce the bearing friction to an insignificant value. The armature core is made of soft laminated sheet steel, of which every sheet is well japanned to reduce eddy currents to a minimum. Where the coils enter and leave the slots they are protected by fiber disks. The coils are firmly held in place in the slots by means of wedges, thus dispensing with band wires. The commutator construction embodies the results of the long experience of this manufacturer in the construction of direct-current motors. The brushgear consists of radial carbon brushes with spiral springs providing adjustable pressure. Heavy braided copper leads carry the bulk of the current from the brushes so that the springs are not heated.

These motors are made either of the open type, as shown, or of the semi-inclosed type, in which a grating cover is placed over the open spaces between

the arms of the commutator-end bearing brackets. The machines are highly efficient and noiseless in operation. By careful balance of the electrical and magnetic design hunting and humming are eliminated. These motors are made in sizes ranging from three to 40 horsepower and for 115, 230 and 550 volts. The machines are of the constant-speed type, but a series of different speeds is available in the various sizes.

Steel Cable Grip.

In erecting pole lines for overhead circuits, an important feature is proper attention to guying the poles so as to maintain a neat and well alined job. Since anything that facilitates the installation of the guys is conducive to more liberal and careful guying and therefore to more durable and attractive construction, a brief description of a new steel cable grip specially designed for easy installation on guy strands should be of interest.

Fig. 1.—Fargo Steel Cable Grip.

Fig. 1 is a close view of this grip and

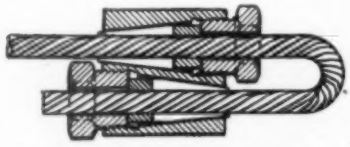


Fig. 2.—Cross-Section of Cable Grip.

Fig. 2 shows its internal construction. From this it is clear that the body consists of two conical wedging shells united in one piece. This body is of very tough steel capable of withstanding many times the stress likely to be ever imposed on it. The more pull that comes on the guy, the better is the grip maintained by the wedging clamp.

The method of installation is shown in Fig. 3. The end of the guy strand is passed through one side of the cable grip, wrapped around the pole or passed through the ring of an eye-bolt on the pole, and again brought through the cable grip, using the other side; the free end of the strand is twisted about a few times. By tightening the set screws of the cable grip it becomes ready to bear any strain.

These cable grips are made in nine different sizes for guy strands ranging from one-fourth inch to one inch in diameter. They are made by the Fargo Manufacturing Company, Poughkeepsie, N. Y.

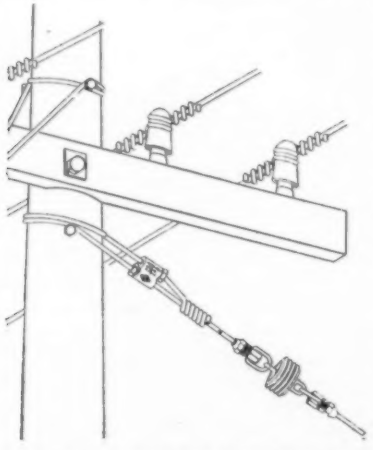
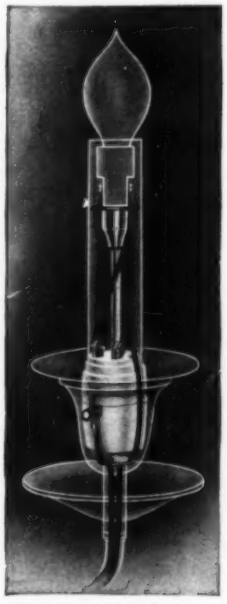


Fig. 3.—Method of Installing Cable Grip.

Cutler-Hammer Candelabra Switch Redesigned.

The candelabra switch shown in the accompanying illustration has recently been redesigned to incorporate a number of improvements. Steel dowel pins are now employed to insure keeping the two parts of the porcelain body in perfect alinement under all circumstances. The supporting spider at the bottom is also redesigned so that the switch is held firmly to the fixture. As before, three, four or five-inch stems can be furnished and the small indicating push-buttons are made in lengths to be used with cups of various diameters.



Candelabra Switch.

The neatness of this switch makes it well suited for fixtures of certain designs where pull chains or projecting keys detract from the simplicity or daintiness of outline. The maker of these switches is the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

New Electric Suction Sweeper.

The outfit illustrated herewith, which was recently placed on the market by the Pneuvac Company, Boston, Mass., is a combination electric carpet sweeper and suction cleaner.

It consists of the old-type carpet sweeper for gathering lint, threads, etc., over the top of which a vacuum cleaner is mounted. The nozzle of the vacuum cleaner precedes the carpet sweeper as it is pushed forward.

The outfit is so constructed that the suction cleaner and carpet sweeper can be used together or separately, as desired. A separate handle is provided for the carpet sweeper to be used when the latter is operated separately. This gives a three-in-one machine, an ordinary carpet sweeper, or suction sweeper, or a combination of the two.

The weight of the suction member is 9.5 pounds and the carpet sweeper weighs 3 pounds. The machine is 8.125 inches high. The case is constructed of beautifully nickeled pressed steel, which makes the outfit very light in weight as well as attractive in appearance. It also provides a smooth inside surface which will not catch dust.

Combination Suction Cleaner and Carpet Sweeper.

The suction cleaner has a 12-inch nozzle with adjustment for height and has an eight-bladed fan. The driving motor is supported above the sweeper in a horizontal position.

Hose connection is made to the machine for cleaning draperies, curtains, etc., by pushing aside the sliding cap at the front of the machine and attaching the hose coupling.

Welding Up Scrap Nickel Anodes.

Some important experiments in the welding of nickel anodes by the oxy-acetylene process have just been concluded in the large plating department of the Prest-O-Lite Company, Incorpo-

rated, at its Indianapolis plant. As a result of these experiments and tests, worn nickel anodes which have previously been scrapped and sold at less than half price are now being reclaimed at a saving of more than 100 per cent.

The anodes used by the Prest-O-Lite Company are castings of 90 per cent nickel, 8 per cent carbon and 2 per cent iron. They are elliptical bars approximately 1.5 inches by 3.5 inches in cross-section and 30 inches long and weigh about 30 pounds. Their market value varies between 46 and 50 cents per pound. On the basis of the latter price, each 30-pound anode has a value of $15.

By welding up old anodes which have been in the solution, and which have a junk value of between 22 and 25 cents per pound, the company is now converting its entire pile of scrap nickel into what are practically new anodes at a total cost for gas and labor of less than six cents per pound. This estimate is based on a recent test at Indianapolis in which 421 pounds of scrap anodes were welded up at the following costs:

463 cu. ft. oxygen (at 2 cents)	$ 9.26
480 cu. ft. acetylene (at 2 cents)	9.60
24 hours labor (at 25 cents)	6.00
Total	$24.86

In view of the fact that this test was made before any experience in the operation had been gained, it is probable that better results and greater savings may result from practice.

The method of handling this operation is about as follows: As the anodes are eaten away by the solution they are turned over to an oxy-acetylene welder who "tacks" on scraps of old anodes by welding to increase the surface. One, two, three and sometimes four pieces of scrap are welded on, depending on the size and weight desired.

The welding flame is also employed to remove the brass hooks which are used to support the anodes while in solution. Under the intense heat of the oxy-acetylene flame (approximately 6,300 degrees Fahrenheit) the solder melts away rapidly, leaving a pure nickel bar which is later welded up.

Thus, by the addition of from, say, 5 to 15 pounds or more of scrap nickel a brand new anode is manufactured at trifling cost and every bit of scrap is utilized without the loss of a single pound of metal.

No flux is employed, as this has been found to be unnecessary. The pieces of scrap are simply melted on or "fused" together, using another piece of nickel as a filling rod.

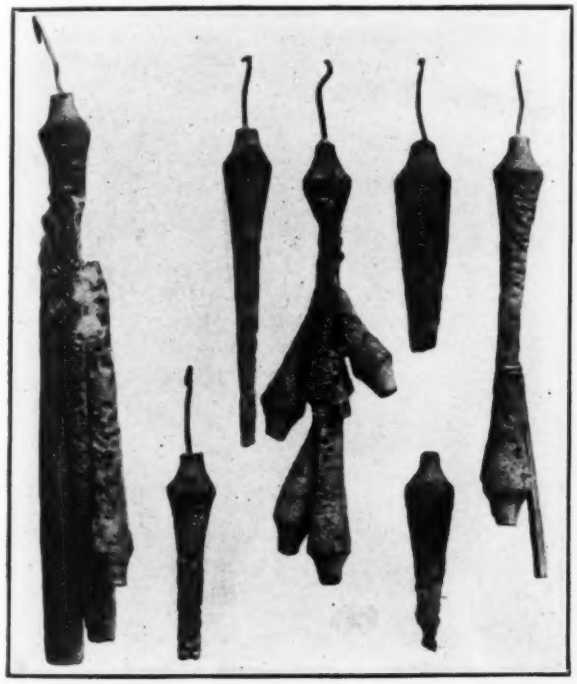
The welding process is a great benefit in obtaining perfect fusion, which is essential as all joints must have electrical conductivity equal to that of new anodes.

Another advantage is the fact that no skill or experience in the art of oxy-acetylene welding is required to weld up scrap nickel anodes. Any workman with average intelligence can do the work without previous knowledge of the process. The apparatus required to do the work is inexpensive.

Many previous attempts have been made to utilize scrap nickel anodes, the most common practice being to drill holes through several pieces and bind them together by means of lead rivets. This method depends upon the contact of the wire or rivet and the piece of scrap to conduct the current and is therefore of uncertain value and in many cases a flat failure. If, for any reason, the contact is bad and offers too much resistance to the current, the metal might or might not dissolve. Therefore by using the welded anodes as much scrap may be used in a tub as is desired without any danger of depleting the solution of metal.

The welding process solves an important problem in the nickel-plating industry as hundreds of tons of scrap nickel anodes can now be utilized at the same value as new anodes and at trifling cost.

The Prest-O-Lite Company estimates that more than a ton a year of scrap anodes can be used in its plating department.



Scrap Nickel Anodes, Before and After Welding.

New Dry-Cell Electric Lanterns.

The rapid increase in popularity of electric lanterns using standard dry cells has suggested the development of lighting outfits calculated to give still longer life and better service by using two cells instead of only one. Such a lantern is illustrated herewith. As is apparent from this view, this is a very compact set. The outer case is made of rolled steel brass-plated and given a brush-brass finish. The lamp and projector combination is designed to give a powerful beam of light, and can be detached from the case; it is provided with four feet of lamp cord, permitting placing of the projector at any desired point, if its position on the battery case should prove unsuitable. This flexibility permits use of the outfit not only on a hand lantern, but also as a table, head, dash or motorcycle lamp. A three-volt high-efficiency tungsten lamp is used. In a test of this outfit it was possible to read one-half-inch print 1,000 feet away.

New Two-Cell Electric Lantern.

Another type of lantern, in this case using a single standard size dry cell, is also shown. The projector in this corresponds to the one described above and also is detachable from the case, permitting use of the outfit in a variety of ways. A metal strap on the back of the case permits carrying the battery on the belt, if the lamp is worn on the cap as a headlamp. The case is made of solid brass given a brush-brass finish. In both of these models a screw switch is used; by screwing this in a continuous light is obtained.

New One-Cell Electric Lantern.

The two lanterns described are but part of the line of so-called "Bright Eye" lanterns made by the Burchwell Manufacturing Company, Pontiac Building, St. Louis, Mo.

Electric Interchangeable Show-Window Sign.

An electrically lighted advertising sign device has been invented and patented by Owen James, of West Boxford, Mass. It consists of a frame, with interchangeable metal letters, stretched across a show window between sashes, or erected on a standard at the back of the window. In the face of the frame are openings with stencil plates, a swinging frame with ground-glass plate mounted within just behind the stencils. Lamps are installed below the stencil plates, the light being thrown into the space behind the ground glass by a reflector located below them. This gives an equal diffusion of light within the chamber and produces a uniform illumination of the sign lettering.

The device is intended to replace printed strips of paper which are glued to the inside of show windows. These are expensive, and the glue is also a disfigurement to the glass. It is claimed the device will quickly pay its cost in the economies it effects.

Brass-Wire Armored Cables for Motorcars and Motorboats.

The Standard Underground Cable Company, Pitttsburgh, Pa., is now manufacturing a complete line of brass-wire-armored ignition, lighting and starting cables for motorcars, motorboats and other motor-driven conveyances. This armor is in the form of a strong D-shaped ribbon wound closely over the cable, and is supplied in yellow, antique or nickel-plated finishes. Galvanized-steel-wire armor is occasionally used, though of somewhat less durable construction.

The insulation of these armored cables consists of high-grade rubber, varnished cambric, and waxed and varnished braids. Other types have plain rubber insulation without braided covering. The outer braid of the braided cables is saturated with multiple coats of special varnish, which gives it durability, even when not further protected by the brass-wire armor.

Brass-Armored Motorcar Cable.

High-Capacity Outdoor Substation on High-Tension Line.

Many high-tension transmission lines pass through districts in need of electric service, and central-station managers realize that under proper conditions profitable loads can be secured.

From the standpoint of operation such service must not only prove profitable, but the type of outdoor substation must be such that it will meet the following conditions:

(1) It must not interfere with the operation of the main lines.

(2) Disturbances at substations caused by short-circuits, overloads or lightning, must be localized.

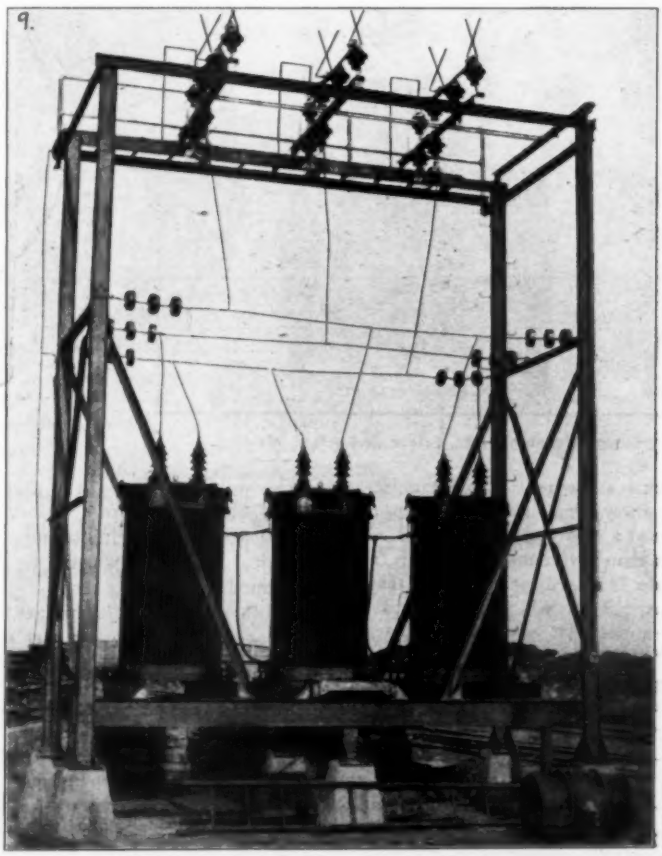
(3) The substation cost per kilowatt must be low, so that the installation will return a profit.

(4) All essential elements must be in plain sight so that their conditions can be noted without difficulty.

(5) The installation must be safe, easily operated, and fireproof.

That these conditions can be met is evidenced by the large number of outdoor substations now in service.

A new form of high-capacity, self-contained, outdoor substation manufactured by the Delta-Star Electric Company, Chicago, Ill., is shown herewith. The design is such that as the demand for current increases, larger transformers can be installed without any change, except increasing the fuse capacity. By means of suitable steps and the top platform rack, a lineman can easily, safely, and quickly inspect the equipment, make adjustments, etc.



Self-Contained Outdoor Steel-Tower Substation.

Synchronous Booster-Converter for Dayton Power & Light Company.

The Dayton Power & Light Company, Dayton, O., in 1913 found it advisable to increase its converting capacity for supplying the direct-current three-wire system. This was done principally to insure its many customers in the center of the city being supplied with continuous service, owing to the fact that the substation equipment had been exposed to immersion at the time of the serious flood. The question of whether the new equipment should be a motor-generator or rotary converter was very carefully considered by the company's engineers, and the converter was finally decided upon, for the following reasons: Smaller conversion losses, less current required for starting, lighter weight, less floor space.

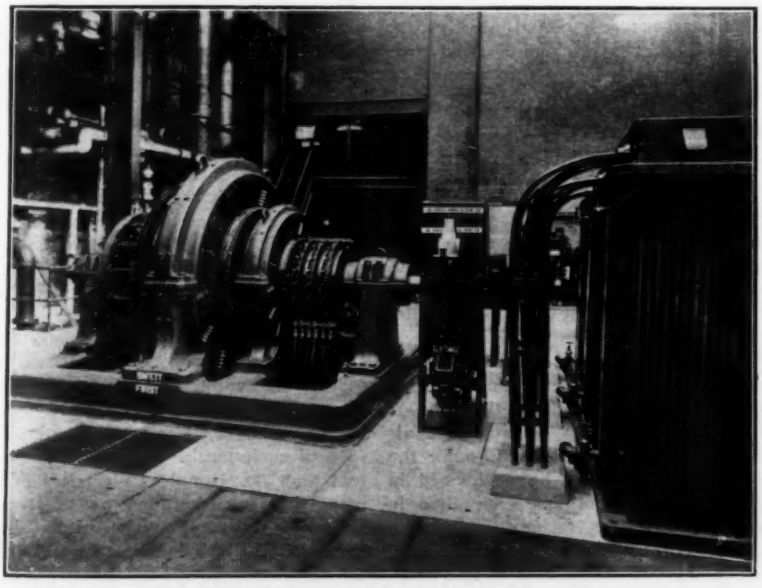
The accompanying illustration shows the new equipment, which was purchased from the Westinghouse Electric & Manufacturing Company, and consists of a 1,000-kilowatt, 250-volt, six-phase, 60-cycle, synchronous booster-converter, operated from three 365-kilovolt-ampere, single-phase transformers with primaries arranged for 13,200, 6,600 or 2,200 volts. At the present time, this unit is operated from a 2,200-volt substation bus, but the other voltages were provided to enable it to be operated at a higher voltage, which will be obtained later when other improvements that are now contemplated will be completed.

This equipment is arranged for both alternating-current and direct-current starting and requires less power for either method of starting than a synchronous motor-generator set of equal capacity. The operators all show a preference for the booster-converter, as it has proved itself a very easy machine to handle, consequently it is in operation a good portion of the time. The direct-current voltage can be varied at will from the switchboard by means of the smaller booster-field rheostat.

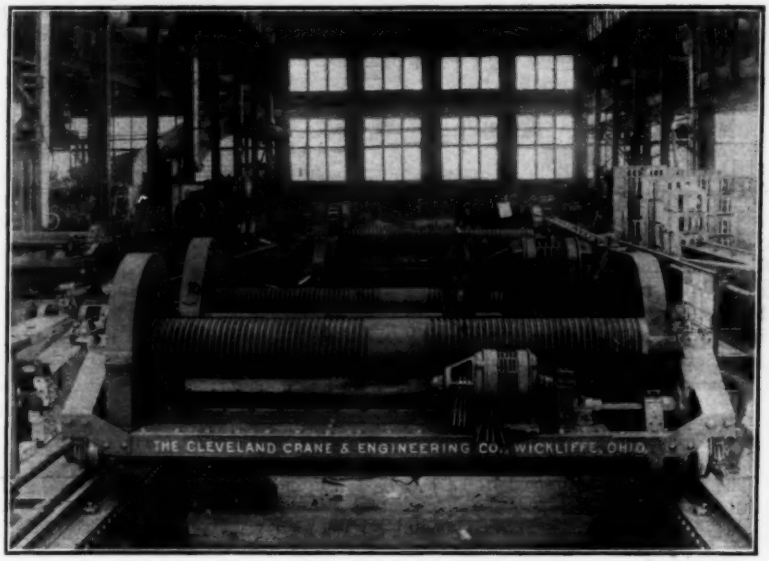
This unit has been in operation for approximately 17 months, and is loaded daily up to approximately 4,400 amperes, which is a 10 per cent overload at the normal voltage. During one extreme condition this machine delivered 5,500 amperes at 230 volts, for approximately 15 minutes. This was due to a voltage disturbance, which caused the motor-generator, with which the rotary was operating in parallel, to fall out of step and disconnect itself from the line. During December, 1914, the converter operated normally 18 hours a day and the average load-factor for the month, taken from the station operating log, proved to be 79 per cent, ranging from a minimum of 70 per cent to a maximum of 89 per cent daily.

In every sense of the word, the booster-converter has met the exacting requirements of central-station operation in a manner entirely satisfactory to the Dayton Power & Light Company.

There seems to be no logical reason for retaining a prejudice against 60-cycle converters, since the machines built today have eliminated the objectionable points that were characteristic of those of earlier design. This is certainly borne out by the operating results obtained in the Dayton installation and that of various companies using modern 60-cycle synchronous converters.



Synchronous Booster-Converter in Dayton Plant.



Electric Cranes for Ford Assembling Shops.

Novel Use of Electric Cranes in Ford Assembling Shops.

An unusual arrangement for the use of electric cranes has been made in the assembling shops of the Ford Motor Company in Cleveland, Cincinnati, Pittsburgh, Atlanta and Long Island City. The cost of handling material is always one of the points which works managements are striving to lower and the plant adopted by the Ford company affords good opportunities for efficiency. The cranes which will be used are shown as they were set up on the assembling floors before shipment. They will be used for unloading material received in bulk from freight cars located on the ground level and for conveying this to the numerous floors in the building. Load platforms are placed on each floor in staggered location and below the crane runway, permitting material to be loaded or unloaded at any floor.

The cranes have a capacity of 50 tons on the main hoist and five tons on their auxiliary hoist with a total possible lift of over 86 feet. The main hoist has four ropes winding on to the drums 8 feet apart and prevent twisting of the ropes.

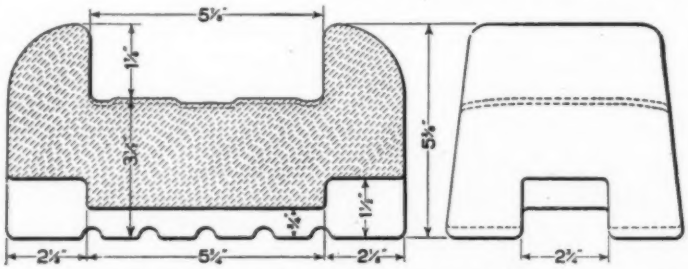
The main hoist will be operated by a 40-horsepower type CI alternating-current induction motor, which is a new Westinghouse motor especially designed for crane and hoist service. The bridge and trolley motors will be of the same type, of 11 and 5 horsepower, respectively. The cranes were made by the Cleveland Crane & Engineering Company, Wickliffe, O.

New Patented Third-Rail Insulator.

The third-rail insulator illustrated herewith is known as the Ohio Brass Company's type K. It is held in position by means of a bar-iron forging lagged to the tie. Across the bottom of the insulator are slots, recesses at each end to provide clearance for lag-screw heads. The forging may be extended to provide a support for a protection board, if so desired. A large number of these insulators have proved highly satisfactory on an important eastern road.

This insulator is covered by the Roger patent No. 1,090,234, issued March 17, 1914, half interest of which has been assigned to Nathan Shute. The Ohio Brass Company, Mansfield, O., has entered into a contract giving it exclusive manufacturing and sales rights for the general market upon third-rail insulators manufactured under this patent.

New Third-Rail Insulator.



Cross-Section and End Elevation of Third-Rail Insulator.

Excellent Performance of Pennsylvania Railroad's Electric Locomotives at New York Terminal.

Some very interesting figures have just been given out concerning the performance of the electric locomotives used by the Pennsylvania Railroad on the Manhattan Division, operating passenger trains through tunnels entering New York City under Hudson River.

These locomotives have been in use for nearly four and one-half years and the data given below represent their performance during the period in a very striking manner.

They were designed to start and accelerate a 550-ton train, in addition to the locomotive, on a 1.93-per-cent grade in tunnels, but in actual operation, 850-ton trains are frequently started on this grade and trains of 14 all-steel cars, weighing over 1,000 tons are handled without difficulty.

Each locomotive in service passes over an inspection pit every 24 hours, when a running inspection of machinery is made, similar to that given steam locomotives over the pit, and slight repairs made where necessary. The average time required for this inspection is approximately ten minutes.

After 3,000 miles run, the locomotives are taken into the shop for a general or periodic inspection, when all electrical apparatus is thoroughly gone over, tested, cleaned and necessary adjustments and renewals made to all electrical and mechanical parts.

The shipping of these locomotives for general repairs is governed by tire wear, and a number of locomotives have run from 90,000 to 112,000 miles before it was necessary to turn the tires or do any general repair work.

The general overhauling and repairing of these locomotives is done in one of the regular steam-locomotive repair shops.

On November 28, 1914, these 33 locomotives had completed four years' service, and during that period the mileage made and dentention record is as follows:

Locomotive-miles	3,974,746
Total engine failures	45
Total minutes detention to trains	271
Locomotive-miles per detention	88,328
Locomotive-miles per minute detention	14,667

During this period, 463,558 train movements were made, or an average of 1,300 movements per detention, due to engine failures.

At Manhattan Transfer, where the change is made from steam to electric locomotive, on trains to and from the Pennsylvania station, the time allowed per schedule for making the change, including necessary testing of air brakes, is four minutes; although the entire operation can be performed in three minutes, and has been done in two minutes.

These locomotives are articulated machines, each consisting of two semi-units, each having a four-wheel bogie truck and two pairs of driving wheels connected by siderods, the semi-units being permanently coupled together at the driving-wheel end. The locomotive frames, driving wheels, trucks and running gear are similar in general character to the standard American type steam locomotive and the relation of the various working parts on the two semi-units is similar in location to two steam locomotives coupled back to back.

Each semi-unit is equipped with a 2,000-horsepower motor connected to the driving wheels through a system of parallel rods and cranks with an intermediate shaft, and is fitted with unit switches, master controller, Westinghouse automatic and straight air-brake apparatus, electric headlight, pneumatically operated whistle, sand apparatus and other items of lesser importance. The locomotive equipment is so arranged that in the event of one motor being cut out of service, the entire locomotive can be operated from the other cab with the remaining motor. The unit-switch control permits two or more locomotives to be coupled and all to be operated from either end of any one cab. The semi-units are interchangeable, and if any two semi-units are separated, they can be combined with any two other semi-units, as may be required in making repairs, or for other reasons. The controllers are fitted with four running notches, giving great flexibility of speed regulation, and permitting the most economical use of power during acceleration.

Each motor has a continuous rating of 1,000 and a maximum rating of 2,000 horsepower, or a total of 4,000 horsepower per locomotive. The motors are of the direct-current, field-controlled, commutating-pole series type. The weight of each motor complete, including cranks, is 43,000 pounds. The motors are supplied with direct current at 650 volts from the third rail, through contact shoes located on either side of each truck. The motors, control and the complete electric equipment was furnished by the Westinghouse Electric & Manufacturing Company, while the locomotives were built by the Pennsylvania Railroad in its own shops at Altoona, Pa.

Latest Approved Fittings

The electrical fittings illustrated and described in this department have been approved by the Underwriters' Laboratories, Incorporated, following examination and tests conducted under standards of the National Electrical Code as recommended by the National Fire Protection Association.

CABINETS. — Johns-Pratt Company, Hartford, Conn.; H. W. Johns-Manville Company, sole agent, New York, N. Y.

Sheet-steel cabinets, catalog Nos. 9551, 9552 and 9553, with sheet-metal adapters for inclosing "Noark" meter-testing cutout bases and protecting the meter terminals.

Listed June 1, 1915.

CABINETS. — Trumbull Electric Manufacturing Company, Plainville, Conn.

Sheet-metal boxes with combination switches and cutouts, catalog Nos. 5630 and 5631.

Listed May 4, 1915.

CONDUIT OUTLET PLATES.—William H. Hope, 33 Green Street, Newark, N. J.

Cast-iron outlet plates with clamps for armored cable. Catalog No. 2, for combination gas and electric light outlets, and catalog No. 4, for straight electric outlets.

Listed May 3, 1915.

CUTOUT BASES, Cartridge Fuse. —The Trumbull Electric Manufacturing Company, Plainville, Conn.

Slate base. 250 volts, all capacities, catalog Nos. 8006, 8007, 8016, 8017. 600 volts, all capacities, catalog Nos. 8056-57, 8066-67.

Listed May 20, 1915.

CUTOUT BASES, Link Fuse.—Johns-Pratt Company, Hartford, Conn.; H. W. Johns-Manville Company, sole agent, New York, N. Y.

"Noark" meter-testing cutout bases for link fuses.

Catalog No. 9514, 31-60 amperes, 250 volts, for use in cabinet, catalog No. 9552.

Catalog No. 9515, 61-100 amperes, 250 volts, for use in cabinet, catalog No. 9552.

Catalog No. 9516, 101-200 amperes, 250 volts, for use in cabinet, catalog No. 9553.

Listed June 1, 1915.

CUTOUT BASES, Plug Fuse.—Johns-Pratt Company, Hartford, Conn.; H. W. Johns-Manville Company, sole agent, New York, N. Y.

"Noark" meter-testing cutout bases for plug fuses.

Catalog No. 9501, 0-30 amperes, 125 volts, catalog Nos. 9505 and 9506, 0-30 amperes, 125-250 volts, for use in cabinet, catalog No. 9551.

Standard when properly installed in the cabinets with which they are listed.

Listed June 1, 1915.

FIXTURES, Supports for. — The Trumbull Electric Manufacturing Company, Plainville, Conn.

"Slotted" fixture hickeys, with malleable-iron nipples threaded on each end for attaching fixture stems to standard insulating joints and fixture studs. Catalog Nos. 31050-59 inclusive, 31082-83, 31085-87 inclusive, 31089 and 31091.

Listed June 1, 1915.

FUSES, Cartridge Inclosed.—Chelten Electric Company, submittor, 314 Armat Street, Philadelphia, Pa. Manunfactured by Killark Electric Manufacturing Company, 2005 Locust Street, St. Louis, Mo.

"Chelten Electric Company" cartridge inclosed fuses, 0-600 amperes, 250 volts.

Listed May 20, 1915.

FUSES, Cartridge Inclosed.—The Trumbull-Vanderpoel Electric Manufacturing Company, submittor, Bantam, Conn. Manufactured by Killark Electric Manufacturing Company, 2005 Locust Street, St. Louis, Mo.

"Trumbull-Vanderpoel" cartridge inclosed fuses, 0-600 amperes, 250 volts.

Listed May 20, 1915.

FUSES, Plug.—The Arrow Electric Company, submittor, Hartford, Conn. The Bryant Electric Company, Bridgeport, Conn., "Arrow" Edison type, 3-30 amperes, 125 volts.

Listed May 20, 1915.

FUSES, Plug.—Connecticut Electric Manufacturing Company, Bridgeport, Conn.

C. E. M. Co., Edison plug fuses, 0-30 amperes, 125 volts. In these fuses horn fiber is used for insulation of live parts and of brass-rimmed mica cap.

Listed June 8, 1915.

FUSES, Plug.—Trenton Electric & Conduit Company, Incorporated, Trenton, N. J.

Edison plug fuses, 0-20 amperes, 125 volts.

Listed June 1, 1915.

GROUND CLAMPS.—Gillette-Vibber Company, New London, Conn.

Type S.

Listed May 25, 1915.

HEATERS, Electric.—General Electric Company, Schenectady, N. Y.

"G. E." heaters, 95-250 volts.

Circulating water heaters, types L-42, L-56, 600-3,000 watts.

Air heaters, type A-52, 1,200-5,000 watts.

Beer vat dryer, type A-44, 3,000 watts.

Listed May 14, 1915.

PANELBOARDS.—The Pelton & Crane Company, 244 Harper Avenue, Detroit, Mich.

Switchboard equipped with cartridge inclosed fuses, flush switches, full-voltage and low-voltage terminals, the latter controlled by rheostats; and operated on either 110-volt alternating-current or direct-current circuits.

Listed June 1, 1915.

RECEPTACLES, For Attachment Plugs.—Central Electric Company, 320 South Fifth Avenue, Chicago, Ill.

Receptacles and plugs. Ralco.

30 amperes, 250 volts, catalog No. 13.

60 amperes, 250 volts, catalog No. 9.

Listed March 31, 1915.

SIGNS, Electric. — Flashtric Sign Works, 213 South Clinton Street, Chicago, Ill.

Electric signs shown by tests and examinations conducted by Underwriters' Laboratories to be in accordance with requirements of the National Board of Fire Underwriters have labels attached.

Listed May 13, 1915.

SWITCH BOXES.—Chicago Fuse Manufacturing Company, 1014 West Congress Street, Chicago, Ill.

Gem type F.

Listed June 2, 1915.

SWITCHES, Knife.—Electric Power Switch Control Company, 253 Fourth Street, Portland, Ore.

Motor-starting switch control, 30 amperes, 250 volts, three-pole, double-throw knife switch with specially designed interlocking slot attachment to control movement of knife switch.

Listed June 1, 1915.

SWITCHES, Surface Snap. — The Trumbull Electric Manufacturing Company, Plainville, Conn.

Two-circuit, two amperes, 250 volts, five amperes, 125 volts, catalog Nos. 330-333, inclusive.

Three-circuit, two amperes, 250 volts, five amperes, 125 volts, catalog Nos. 334-337, inclusive.

Listed May 18, 1915.

THEATER APPLIANCES.—General Electric Company, Schenectady, N. Y.

G. E. stage cable connectors.

Double-pole receptacles and plugs with current-carrying parts mounted in fiber blocks.

35 amperes, 125 volts, catalog No. 79825.

10 amperes, 125 volts, catalog No. 79826.

Standard only for portable stage appliances.

Listed April 27, 1915.

Current Electrical News

ATLANTIC STATES.

SPRINGFIELD, MASS.—The United Electric Light Company plans to expend $40,000 for various improvements. Address Walter L. Mulligan, manager.

HARRISON, N. J.—The Public Service Electric Company will install a new underground conduit system in Fourth Street, replacing its present overhead lines. The improvement is estimated to cost $35,000. A.

JERSEY CITY, N. J.—City Commissioner Henry Byrne has approved of the installation of an improved street-lighting system on Jackson, Ocean, Central and Monticello Avenues, and Grove Street, in accordance with plans recently under contemplation; the new system is planned to comprise flaming arcs on ornamental poles. The Public Service Electric Company has been asked to make the installation for the city. A.

TRENTON, N. J.—The Hudson & Middlesex Telephone & Telegraph Company is planning for the construction of an independent telephone line from New York to Washington, and has made application to the Board of Public Utility Commissioners for approval of a $1,000,000 mortgage, the proceeds to be used for this purpose. William J. Lansley, Perth Amboy, is an official of the company. A.

SCALP LEVEL, PA.—An application for a Pennsylvania charter was recently filed by the Scalp Level Electric Company, of Scalp Level, Pa., by Thomas Fisher, B. L. Simpson and E. L. Delaney. The concern will supply and manufacture light, heat and power by electricity to the people of Scalp Level. S.

NORTH CENTRAL STATES.

DAYTON, O.—The Dayton Power and Light Company has been granted permission by the State Utilities Commission to issue $665,000 worth of new securities, $300,000 of which will be used to pay for improvements.

FREMONT, O. — The Sandusky River Power Company has increased its capital from $900,000 to $1,000,000 and changed its name to the Ohio State Power Company.

TROY, O.—A resolution has been prepared to sell $10,000 worth of bonds on July 2, the proceeds to be used for the purpose of improving the Miami county power plant. Address President of Board of Local Improvements.

ALBANY, ILL.—The electric light plant will be improved. Address mayor.

APPLETON, WIS.—The Wisconsin Traction, Light, Heat and Power Company will spend approximately $500,000 increasing the capacity of its Appleton power plant during the ensuing 12 months, according to a statement made by John I. Beggs, president of the company.

LACROSSE, WIS.—Plans have been completed by the Wisconsin-Minnesota Light and Power Company for the erection of a new power station and the rehabilitation of its central heating system in LaCrosse at an expenditure of $210,000. The new station will be a stand-by steam plant to be operated in conjunction with plants of the corporation at Chippewa Falls, Eau Claire and Winona. Hydroelectric power will also be brought into La Crosse from the water-power station at Eau Claire and Chippewa Falls.

CHISHOLM, MINN.—A station is to be erected and a number of lights are to be installed at the new park on Longyear Lake by the Mesaba Electric Railway Company, of which E. W. Reynolds is general superintendent. X.

HIBBING, MINN.—A plan is being talked whereby this village may furnish electric light for Leetonia. X.

MINNEAPOLIS, MINN.—Plans are being prepared by the C. L. Pillsbury Company for a new $50,000 power plant to be built by St. Joseph's hospital, St. Paul. A considerable amount of new machinery, boilers, engines, generators, etc., will be needed. Bids will be advertised for shortly. C. H. Johnson, St. Paul, is architect. X.

BARCROFT, IOWA.—Bonds to the amount of $10,000 will be issued for an electric plant. Address city clerk.

HAZELTON, IOWA.—The proposition to issue bonds for electric light plant carried. Address Mayor.

LAKEFIELD, IOWA.—The proposition to issue $31,000 in bonds in order to properly equip the electric light plant and furnish adequate fire protection, carried. Address Mayor.

KANSAS CITY, MO. — The Big Niangua Hydroelectric Company, of Kansas City, is to build a hydroelectric plant as soon as finances can be arranged, on the Big Niangua River. The estimated cost, $2,500,000, and the construction will include a reinforced-concrete dam, 1,500 feet long and 160 feet high, to develop 30,000 horsepower, to be delivered over a transmission line 120 miles long.

KANSAS CITY, MO.—An ordinance granting a revocable permit to the Western Union Telegraph Company to lay ducts and conduits for wires and pneumatic tubes in the streets, is pending in the Council. The company had received a permit from the Board of Public Works. There was a demand that a franchise be required, but the permit was the outcome of negotiations, under which the city will receive $250 a mile per year, and the use of 9,200 feet of tube free.

LINDEN, N. D.—A. M. Baker, of Morris, Minn., is to expend $7,000 on the installation of an electric light plant here. X.

SOUTH CENTRAL STATES.

BOWLING GREEN, KY.—Articles of incorporation have been filed here by the Smiths Grove Light and Ice Company, at Smiths Grove, this county. The company has $5,000 authorized capital, and the incorporators are J. G. Edwards, principal stockholder, and J. T. Smith and Edgar Beeler.

BRAEMAR, TENN.—Cost of the plant which the Braemer Power Company projects at Braemar Falls, is estimated at $60,000. As previously noted, the company proposes to construct a pipe dam and pipe line with a 554-foot fall, and to transmit electricity as far as Elizabethton, seven miles. L. D. Gastieger is secretary.

DALLAS, TEX.—It is stated by Mayor Henry D. Lindsley that the construction of a municipal electric light plant here will be probably undertaken if the suit which is now pending in the courts to determine the validity of the issue of $400,000 of bonds that were voted for the purpose more than a year ago, is decided favorably.

GALVESTON, TEX.—The Texas Power and Light Company has purchased the holdings of the Galveston Gas Company for a consideration of approximately $1,000,000. Extensive improvements will be made to the plant. D.

MARSHALL, TEX.—The Marshall Electric Company plans to build an extensive system of power transmission lines in this section. The first line to be constructed will run from the central station here to Jefferson, a distance of fifteen miles. D.

WESTERN STATES.

DILLON, MONT.—The citv of Dillon, according to City Engineer William E. Chapman, will install a modern lighting system. Reported the installation will consist of single and three-light units, distributed in the business and residence section. Understood bids for materials and installation will be called for shortly. O.

ALBION, IDAHO.—The city council has granted a franchise for light and power in this city to the Washington Water Power Company, of Spokane. It is understood the company will immediately begin the extension of its lines and distributing systems. O.

BLACKFOOT, IDAHO.—Manager Hughes of the Southern Idaho Water Power Company and the city council are negotiating for the installation of a lighting system in this city. It is understood an agreement has been reached whereby the company will install the system and furnish current for operation. O.

YUMA, ARIZ.—W. R. Webb, of Gadsden, has been awarded franchises for the installation of electric-light, water works and telephone and telegraph systems in this city.

EUGENE, ORE.—B. B. McKinney, of the Eugene Water Board, states the electric substation transformers and other electrical equipment will be removed from the filter building to the new substation at once. Reported the municipal system will be extended and improved in a small way this summer. O.

OREGON CITY, ORE.—An agreement has been reached between the city council and the business men on Main Street whereby a new cluster-lighting system will immediately be installed on that thoroughfare. According to present plans there will be six light posts in each block. O.

ABERDEEN, WASH.—By an overwhelming majority voters of this city at a special election held recently, refused to grant an electric light and power franchise to George Tilden and associates, of Seattle. Mr. Tilden, who has petitioned nearly every large city in Southwestern Washington for a like franchise, purposes developing a power site on the White River, in the vicinity of Tacoma. O.

MONTESANO, WASH.—Recently the Northwest Electric and Waterworks Company issued $500,000 worth of bonds for the purpose of making needed extensions and improvements in Montesano and immediate vicinity. The mortgage was given by the Northwest Trust and Safety Deposit Company, as trustee. This company, at this time, is building a new power plant on the Chehalis River. O.

PROPOSALS.

LIGHTING FIXTURES. — Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until July 26, for lighting fixtures for the new United States post office at Webb City, Mo. Drawings and specifications may be obtained from custodian of site at Webb City, Mo., or at the office of the Supervising Architect, Washington, D. C.

LIGHTING FIXTURES. — Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, Washington, D. C., until July 30, for interior lighting fixtures for the United States post office at Albion, Mich. Drawings and specifications may be obtained from the custodian of site at Albion, Mich., or at the office of the Supervising Architect, Washington, D. C.

PANAMA CANAL ELECTRICAL SUPPLIES.—Sealed proposals will be received until July 1, at the office of the General Purchasing Officer of The Panama Canal, Washington, D. C., for furnishing, by steamer, free of all charges, on dock at either Colon (Atlantic port) or Port of Ancon (Pacific port), Isthmus of Panama, the following: Galvanized corrugated roofing, electrolytic oxy-hydrogen-generating plant, electric cable, cable-end bells, circuit-breaker, glass lamp shades, battery zincs, dry cells, pipe fittings, in accordance with Circular No. 935.

NEW PUBLICATIONS.

BOILER OPERATION.—Bulletin No. 78 of the Engineering Experiment Station of the University of Illinois is entitled "A Study of Boiler Losses," by A. P. Kratz. This bulletin gives a critical analysis of data taken from a series of 25 trials made on a 500-horsepower boiler in the University plant. Copies of the bulletin may be obtained gratis from C. R. Richards, Acting Director, Urbana, Ill.

INDUCTANCE. — Scientific Paper No. 246 of the Bureau of Standards, Washington, D. C., is entitled "Methods of Measuring the Inductances of Low-Resistance Standards," by F. Wenner, E. Weibel and F. B. Silsbee. Two methods, with applications, are given.

INSTRUCTIONS IN SWITCHING. —A. P. Lundberg & Sons, 477 Liverpool Road, London, England, has published a third edition of the booklet entitled "The Teaching of Electric Light Switching," which aims at systematizing the teaching of this usually ignored branch of electrical application. The booklet is sent free upon application.

FORD ENGINE TROUBLES.—The Norman W. Henley Publishing Company, 132 Nassau Street, New York City, has published a chart by Victor W. Page entitled "The Location of Ford Engine Troubles Made Easy." Illustrations of the parts are given, with tabulated suggestions as to where to look for trouble. The price is 25 cents.

CLEVELAND MUNICIPAL PLANT. —A bulletin issued by the City of Cleveland Department of Public Utilities gives a progress report of the municipal electric light plant, prepared by F. W. Ballard. This gives figures showing what has been accomplished by the new plant, and refutes a number of misstatements which have been published in regard to it.

INDUSTRIAL ACCIDENTS.—The United States Department of Labor has issued Bulletin No. 157 entitled "Industrial Accidents Statistics." This gives tables of the number of casualties in the different states, with a classification of the same. An analysis and discussion of the statistics of Illinois, Massachusetts, New York and Wisconsin makes up a large part of the bulletin.

ANNUAL REPORT OF SUPERVISING ENGINEERS, CHICAGO TRACTION.—The sixth annual report of the Board of Supervising Engineers, Chicago Traction, covering the fiscal year ended January 31, 1913, has been published in the form of a volume of 534 pages. The report gives a summary of the proceedings of the board, discusses the relation of suburban traction development to that in the city of Chicago proper, and gives an analytical review of the operation and rehabilitation periods of the various street-railway companies, records the growth of population and earnings, discusses in a general way the subject of passenger subways to relieve congestion, and reviews the relations of the municipality to the companies. As usual, detailed reports are included from the various departments of the engineering and accounting staffs. Comprehensive data and a large number of illustrations accompany the report.

NEW INCORPORATIONS.

DETROIT, MICH. — The Eagle Electric Company has been incorporated with a capital of $100,000.

CHICAGO, ILL. — The Eastern Electric Sales Company has changed its name to the International Electric Company.

VAN WERT, O.—The Northwestern Ohio Light Company has been incorporated with a capital of $10,000 by Lindsey Hooper, U. S. Brandt, J. H. Brandt, C. A. Radcliffe and W. P. Hurd.

CLEVELAND, O.—The Advance Electric Company has been organized with a capital of $2,000, by J. W. Abel and others.

FOX LAKE, WIS.—The Fox Lake Light and Power Company, has been incorporated with a capital of $5,000, by D. C. West and others.

EL CAMPO, TEX.—Central Service Company. Capital stock, $200,000. Incorporators: F. J. Hardey, W. J. Hefner, E. L. Correll and others.

ELIZABETHTOWN, KY. — The Horse City Light and Power Company has been incorporated with a capital of $10,000, by J. P. Todd and others.

CLEVELAND, O.—The Advance Electric Company. Capital, $2,000. Incorporators are J. W. Abel, Willia Langer, W. R. Winn, Z. F. Harris and O. J. Buckley.

EMMETSBURG, ME.—The Emmetsburg Electrical Company has been organized to erect, maintain and operate electric power plants. Capital stock, $35,000.

CINCINNATI, O.—The Home Electric Company. Capital, $10,000. Incorporators: W. C. Adams, F. L. Wanderer, H. L. Town, C. G. Andrews and L. J. Adams.

LAKETON, IND.—The Akron and Lakeland Utility Company has been organized to build an electric plant at Laketon. The new concern will be capitalized at $25,000.

CEDARVILLE, ILL. — Cedarville Park Power and Electric Company. Capital, $5,000. Incorporators are William M. Clingman, John Bollman and Smith C. Thompson.

CLEVELAND, O.—The Ohio Electric and Manufacturing Company. Incorporators are Harry Frankel, Dave Frankel, Morris Shapero, H. A. Kangesser and Frieda Frankel.

ATHENS, O.—The Central Electric Producing Company. Capital, $300,000. Incorporators: H. D. Manington, O. E. Harrison, H. C. Allread, E. H. Davis and H. R. Schweinsberger.

EL CAMPO, TEX.—The Central Service Company has been incorporated with a capital of $200,000 by F. J. Hardey and others, to deal in ice, electric light and power, etc.

BUFFALO, N. Y.—The Buffalo Light Company has recently been incorporated with a capital stock of $10,000. The incorporators are S. N. Rogers, of Doby Springs, D. G. Rogers, of Buffalo.

ROCHESTER, N. Y.—The Rochester Electrical Supply Company has been incorporated with a capital of $25,000, by Carl F. W. Kaelber, Clarence M. Platt, Bernard E. Finucane, all of Rochester.

NEW YORK, N. Y.—United States Six-in-One Sales Corporation. To manufacture electrical appliances. Capital, $5,000. Incorporators: John H. Wallace, Russell D. Burchard and Agnes Wyman.

NEW YORK, N. Y.—Kammer Advertising Company, Incorporated. Electric signs, etc. Capital, $5,000. Incorporators: Francis Kammer, Max A. Kammer, and William B. Whelpley, of New York City.

NEW YORK, N. Y.—The Opalescent Bent Glass Company, Incorporated; art glass work, electric light fixtures, globes, etc. Capital, $10,000. Incorporators, Simon H. Lewis, William

S. Evans, and Henry Altbach, all of New York City.

NEW YORK, N. Y.—Charles R. Gracie, Incorporated. To manufacture electric novelties, electric wooden lamps, etc. Capital, $5,000. Incorporators: Charles R. Gracie, Charles Deimling and Edward J. Dunn.

PORTLAND, ORE.—Articles of incorporation have been granted the Light House Electric Company. The company is capitalized at $4,000. Incorporators are George L. Boynson, L. Welch and Jennie A. Robeson.

NEW YORK, N. Y.—Cleveland Sales Company, Incorporated; to deal in motors, dynamos, generators, etc. Capital, $10,000. The incorporators are Joseph O. Laino, Norman N. Rulisom, and M. Anton, of New York City.

NEWARK, N. J.—The Beaver Electric Lamp Company has been incorporated with a capital of $100,000, to manufacture electric lamps. The incorporators are Edmund Beatty, Frederick Rosseter and Philip Dreyfuss.

GLENSIDE, PA.—The Brockline Underground Electric Manufacturing Company was recently incorporated with a capital of $5,000, to manufacture electrolysis bonds, tools and do underground construction. President, E. L. Brocking; Treasurer, T. C. Allen.

ALBANY, N. Y. — The Western Power Corporation was incorporated recently with a capital of $7,080,000. The directors of the new concern are Charles F. Ayer, John R. Freeman, Frank H. Davis, Richard M. Reed, Benjamin F. Yoakum and Richard B. Young.

EL CAMPO, TEX.—The Central Service Company has been organized here with a capital stock of $200,000, for the purpose of building and operating an electric light and power plant. It will construct a system of power transmission lines to neighboring communities and farms. P. J. Hardy is interested. D.

CHICAGO, ILL.—The Pittsburgh Electric Specialties Company of Pittsburgh, Pa., was recently incorporated in the State of Illinois with a capital of $50,000. The company has opened offices at 218 South Wabash Avenue, Chicago. Attorney-in-fact in Illinois is A. C. Wales. The concern recently incorporated in Pennsylvania. S.

LOUISVILLE, KY.—The West Engineering Company has been incorporated here with $5,000 capital, William M. West, principal stockholder, the incorporators including Irvin Marcus and Leon Lewis. Headquarters have been established at 233 South Fifth Street. The corporation proposes to install and operate power plants and fuel-saving devices, paying particular attention to getting efficiency out of power equipments. G.

SPRINGFIELD, MASS.—The New England Westinghouse Company has been incorporated under the laws of Massachusetts, with a capital of $2,000,000. The incorporators are George H. Cox, Carl A. DeGorsdorff, George C. Wing and S. St. John Morgan. The new company will operate the plants of the J. Stevens Arms and Tool Company and the Stevens-Duryea Company, which have recently been acquired by the Westinghouse interests. The entire stock of the new company is owned by the Westinghouse Electric & Manufacturing Company.

FINANCIAL NOTES.

The Kanawha Traction and Electric Company, recently formed by a consolidation of the Kanawha Traction Company and the Parkersburg, Marietta and Interurban Railway Company has sold $1,000,000 notes to a syndicate formed by the Fidelity Trust Company, of Baltimore.

West Virginia Traction and Electric Company, a subsidiary of Eastern Power and Light Corporation, has sold to a syndicate formed by William P. Bonbright & Company and William Morris Imbrie & Company, New York, $1,500,000 two-year six-per-cent bond secured notes, which are being offered at 98 and interest. The collateral behind the notes consists of $1,875,000 first and refunding six-per-cent bonds deposited with the Bankers Trust Company as trustee. Earnings of West Virginia Traction and Electric for the year ended April 30, 1915, were approximately two and one-half times the requirements for the interest on these notes, and the company is paying dividends at the annual rate of seven per cent on its preferred and five per cent on its common stock.

The meetings of the stockholders of the Westinghouse Electric and Manufacturing Company and of the Westinghouse Machine Company were held Wednesday afternoon, June 9, at the offices of the two companies in East Pittsburgh, Pa., and the following directors were elected: Westinghouse Electric and Manufacturing Company, Edwin F. Atkins, Charles F. Brooker and E. M. Herr, four years; John R. McCune and Jerome Hamauer, three years; Westinghouse Machine Company, J. D. Callery, E. M. Herr, H. T. Herr, William McConway, John R. McCune, Joseph W. Marsh, L. A. Osborne, Guy E. Tripp and H. H. Westinghouse, one year.

Dividends.

	Term.	Rate.	Payable.
Am. Tel. & Tel.	Q	2 %	July 15
Asheville Pr. & Lt. pf.	Q	1.75%	July 1
Cal. Ry & Pr. prior pf.	Q	1.75%	July 1
Can. Westghse	Q	1 %	July 10
Carolina Pr. & Lt. pf.	Q	1.75%	July 1
Colo. Springs Lt., Ht. & Pr.	Q	1.5 %	July 1
Columbus Ry., Lt. & Pr. pf.	Q	1.5 %	July 1
Con. Traction	S-A	2 %	July 15
Detroit Edison	—	1.75%	July 15
Dom. Pr. & Lt. Ltd. pf.	—	2 %	July 15
East. Mich. Edison	—	1 %	July 1
Elec. Stor. Battery	Q	1 %	July 1
Halifax Tramways	Q	2 %	July 2
Kan. Gas & Elec. pf.	Q	1.75%	July 1
New England Pr.	Q	1.5 %	July 1
New England Tel. & Tel.	Q	1.75%	June 30
N. Y. State Rys.	Q	1 %	July 1
N. Y. State Rys. pf.	Q	1.25%	July 1
Otis Elevator	Q	1.25%	July 15
Otis Elevator pf.	Q	1.5 %	July 15
Reading Trac.	S	1.5 %	July 1
Republic Ry. & Lt. pf.	Q	1.5 %	July 15
Shawinigan Water & Pr.	Q	1.5 %	July 10
So. New Eng. Telep.	Q	1.75%	July 15
Wash. Water Pr.	Q	$1.50	July 1
West India Elec.	Q	1.25%	July 1
Westghse Elec. Mfg.	Q	1 %	June 30

Reports of Earnings.

REPUBLIC RAILWAY & LIGHT.

	1915	1914
March gross	$242,236	$246,882
Net after taxes	85,097	92,171
Surplus after charges	28,257	36,208
Balance after preferred dividends	2,300	10,251
Three months' gross	724,837	739,118
Net after taxes	268,258	273,268
Surplus after charges	97,625	106,586
Balance after preferred dividends	19,754	28,715

KEYSTONE TELEPHONE COMPANY.

	1915	1914
May gross	$113,548	$110,825
Net	58,886	56,502
Surplus	32,375	30,698
Five months' gross	557,277	544,822
Net	281,113	276,267
Surplus	148,994	146,604

MT. WHITNEY POWER & ELECTRIC.

	1915	1914
April gross	$ 56,692	$ 56,557
Net after taxes	36,167	32,900
Surplus after charges	23,052	21,160
Twelve months' gross	691,301	643,237
Net after taxes	415,793	33,732
Surplus after charges	266,593	211,277

GRAND RAPIDS RAILWAY.

	1915	1914
April gross	$ 83,353	$ 101,454
Net after taxes	16,328	34,438
Surplus after charges	2,626	20,900
Twelve months' gross	1,258,480	1,300,544
Net after taxes	423,380	475,137
Surplus after charges	261,218	313,691
Balance after preferred dividends	186,218	238,691

UTAH SECURITIES CORPORATION.
Consolidated earnings of subsidiaries.

	1915	1914
April gross	$ 376,470	$ 378,336
Net earnings	205,113	179,806
March gross	364,943	374,811
Net earnings	184,115	181,995
February gross	361,307	360,088
Net earnings	178,280	184,186
January gross	386,943	390,345
Net earnings	199,167	202,942
Four months' gross	1,489,663	1,503,580
Net earnings	766,675	748,929

PACIFIC LIGHT & POWER.

	1915	1914
April gross	$231,339	$208,363
Net after taxes	152,503	125,086
Other income	10,910	13,509
Total income	163,414	138,595
Surplus after charges	55,602	33,964
Four months' gross	909,761	843,017
Net after taxes	591,983	474,369
Other income	44,642	62,780
Total income	636,625	537,150
Surplus after charges	204,536	153,007

COLUMBUS RAILWAY, POWER & LIGHT.

	1915	1914
April gross	$ 247,363	$ 248,748
Net after taxes	95,523	94,663
Surplus after charges	56,312	53,463
12 months' gross	3,074,166	3,040,893
Net after taxes	1,212,412	1,079,044
Surplus after charges.	738,585	591,805
Balance after preferred dividends	453,462	306,682

CUMBERLAND COUNTY POWER & LIGHT.

	1915	1914
April gross	$ 186,786	$ 186,734
Net after taxes	74,965	71,026
Surplus after charges	4,562	7,281
12 months' gross	2,543,812	2,407,857
Net after taxes	1,106,328	1,023,139
Surplus after charges	343,368	281,665
Balance after preferred dividends	205,368	143,665

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

	June 21.	June 14.
American Tel. & Tel. (New York)	123½	122½
Commonwealth Edison (Chicago)	134	134
Edison Electric Illuminating (Boston)	237	236½
Electric Storage Battery common (Philadelphia)	54¾	54
Electric Storage Battery preferred (Philadelphia)	54¾	54
General Electric (New York)	172	172⅝
Kings County Electric (New York)	119	119
Massachusetts Electric common (Boston)	4⅝	—
Massachusetts Electric preferred (Boston)	36½	35¼
National Carbon common (Chicago)	140	140
National Carbon preferred (Chicago)	117½	—
New England Telephone (Boston)	—	127
Philadelphia Electric (Philadelphia)	23¾	24¼
Postal Telegraph and Cables common (New York)	79	79
Postal Telegraph and Cables preferred (New York)	65	—
Western Union (New York)	66½	67½
Westinghouse common (New York)	97	98⅛
Westinghouse preferred (New York)	125	120

PUGET SOUND TRACTION, LIGHT & POWER.

	1915	1914
March gross	$ 615,210	$ 713,650
Net after taxes	213,628	276,790
Surplus after charges	32,387	101,539
12 months' gross	8,169,612	8,713,435
Net after taxes	3,231,192	3,698,411
Surplus after charges.	1,096,143	1,613,646

CLEVELAND ELECTRIC ILLUMINATING.
(Central States Electric Corp. Subsidiary).

	1915	1914
April gross	$ 373,810	$ 374,123
Net after taxes	191,082	183,327
Surplus after interest, amortization and preferred dividends	155,648	147,296
Balance after depreciation	118,267	109,883
12 months' gross	4,253,279	4,205,823
Net after taxes	2,041,727	2,043,033
Surplus after interest, amortization and preferred dividends	1,620,085	1,631,172
Balance after depreciation	1,194,758	1,211,615

NORTHERN OHIO TRACTION & LIGHT.

	1915	1914
April gross	$ 279,282	$ 287,719
Net after taxes	95,744	114,397
Surplus after charges	44,321	64,066
Balance after preferred dividends	27,998	48,344
Four months' gross	1,101,351	1,080,884
Net after taxes	391,900	412,582
Surplus after charges.	187,463	212,427
Balance after preferred dividends	122,173	152,236

PHILADELPHIA RAPID TRANSIT.

	1915	1914
May gross	$ 2,070,160	$ 2,178,842
Net	856,220	918,332
Surplus after charges	83,902	112,859
Eleven months' gross	21,846,996	22,195,755
Net	9,146,851	9,105,773
Surplus after charges	228,070	287,963

BRITISH COLUMBIA ELECTRIC.

	1915	1914
April gross	$ 540,861	$ 698,508
Net after taxes	55,308	195,962
Ten months' gross	6,295,905	7,450,590
Net after taxes	1,284,860	2,024,821

GEORGIA RAILWAY & POWER.

	1915	1914
May gross	$ 514,007	*$ 568,878
Expenses and taxes	294,428	309,632
Net earnings	219,579	259,246
Five months' gross	2,646,696	2,575,699
Expenses and taxes	1,563,317	1,477,828
Net earnings	1,085,379	1,097,871

*Large receipts in May, 1914, due to National Convention of Shriners.

NEW ENGLAND POWER.

Five months ended May 31, 1915:

	1915	1914
Gross earnings	$557,236	$430,148
Net after taxes	361,960	271,192
Balance after bond interest	204,242	132,171
Surplus after other interest	183,629	122,606
Balance after preferred dividends	61,358	19,856

CLEVELAND ELECTRIC ILLUMINATING.
(Central States Electric Corporation Subsidiary.)

	1915	1914
May gross	$ 349,550	$ 348,058
Net after taxes	173,133	162,788
Surplus after interest, preferred dividends and amortization	137,698	126,024
Balance after depreciation	102,743	91,219
Five months' gross	1,928,366	1,929,537
Net after taxes	1,005,240	947,008
Surplus after interest, preferred dividends and amortization	828,086	764,082
Balance after depreciation	635,248	571,128
Twelve months' gross	4,254,772	4,246,805
Net after taxes	2,052,071	2,053,418
Surplus after interest, preferred dividends and amortization	1,631,759	1,638,390
Balance after depreciation	1,206,282	1,214,735

VIRGINIA RAILWAY & POWER.

	1915	1914
May gross	$ 407,694	$ 433,497
Net	204,122	230,004
Net after charges	66,118	92,430
Eleven months' gross	4,679,421	4,717,587
Net	2,415,837	2,465,121
Net after charges	899,343	971,000

COLUMBIA GAS & ELECTRIC.

Columbia Gas & Electric Company and the Union Gas & Electric Company report consolidated income accounts for the fiscal year ended December 31, 1914, as follows:

	1914	1913
Gross earnings	$5,851,537	$5,497,959
Expenses and taxes	2,678,017	2,574,644
Net earnings	3,173,520	2,923,316
Other income	470,864	471,584
Total income	3,644,384	3,394,900
Cin. G. & E. rentals	1,788,552	1,788,250
Cin. Gas Tr. rentals	708,305	718,208
Interest U. G. & E. Co.	80,949	79,172
U. G. & E. earnings to stock not owned	586	325
Interest Columbia G. & E. first 5s	516,240	499,225
Interest Columbia G. & E. debentures	123,262	61,600
Other interest Columbia Gas & Electric	35,452	28,298
Surplus	391,038	219,121
Sinking fund Col. G. & E. first 5s	95,005	95,005

EAST ST. LOUIS & SUBURBAN.

	1915	1914
April gross	$ 193,827	$ 213,998
Net after taxes	74,289	70,671
Surplus after charges.	13,293	14,963
12 months' gross	2,531,939	2,745,570
Net after taxes	1,012,278	1,043,733
Surplus after charges	274,476	436,643
Deficit after preferred dividends	25,524	*99,143

*Surplus.

NASHVILLE RAILWAY & LIGHT.
(Tennessee Railway, Light & Power Subsidiary).

	1915	1914
April gross	$ 176,040	$ 186,150
Net after taxes	72,091	69,756
Surplus after charges	30,099	28,418
12 months' gross	2,216,599	2,228,645
Net after taxes	921,623	824,152
Surplus after charges	430,504	343,933
Balance after preferred dividends	305,504	218,933

CHATTANOOGA RAILWAY & LIGHT.
(Tennessee Railway, Light & Power Subsidiary).

	1915	1914
April gross	$ 87,745	$ 90,429
Net after taxes	29,212	32,828
Deficit after charges	79	*5,232
12 months' gross	1,049,582	1,200,748
Net after taxes	344,566	483,247
Deficit after charges	1,627	*171,674

*Surplus.

NEW YORK RAILWAYS.

	1915	1914
April gross	$ 1,127,388	$ 1,148,888
Net after taxes	323,288	319,598
Other income	46,228	31,626
Total income	369,516	351,224
Interest on underlying bonds	225,520	224,887
Income available for interest on company's bonds	143,995	126,337
Interest on refunding 4s	60,173	54,320
Surplus	83,822	72,016
Ten months' gross	11,126,974	11,485,016
Net after taxes	3,130,581	3,257,097
Other income	422,804	321,170
Total income	3,553,384	3,578,267
Interest on underlying bonds	2,288,024	2,256,491
Income available for interest on company's bonds	1,265,360	1,321,776
Interest on refunding 4s	571,192	543,198
Surplus	694,168	778,578
Passengers carried	220,808,262	226,341,746

PERSONAL MENTION.

MR. F. H. BETHELL, vice-president of the New York Telephone Company, has been elected village president of Scarsdale, N. Y.

MR. WILLIAM J. ROONEY has been appointed Inspector of Wires for the city of Waltham, Mass. He is a graduate of Massachusetts Institute of Technology, 1915.

MR. HENRY G. HAFNER, of the Central Electric Company, Chicago, Ill., is receiving the congratulations of his many friends on his marriage, June 22, to Miss Louise N. Nichols. After a month's honeymoon in Glacier National Park, Mr. and Mrs. Hafner will make their home in Chicago.

MR. H. T. MATTHEW has been appointed Pacific Coast representative of the Society for Electrical Development. Mr. Matthew has been in the United States since 1898. He entered the employ of the McGraw Publishing Company a few years later, and represented them on several of their publications, for the past three years being located on the Pacific Coast. Mr. Matthew is widely acquainted among electrical men, and his standing in the industry and ready faculty for making and holding friends make him a strong addition to the excellent organization already in the field working for the society.

MR. F. W. SCHUSTER has resigned his position as advertising manager of the Meadows Manufacturing Company, Pontiac, Ill., manufacturers of electrically-operated washing machines and other portable and stationary steel-frame apparatus, to accept a similar position with the A. H. Anderson Printing Company at Streator, Ill. The latter company specializes in catalog, folder and other commercial printing, as well as loose-leaf systems, bookkeeping sets, etc. One of Mr. Schuster's first duties in his new position will be to prepare copy and layouts for electrical manufacturers and jobbers who purchase their printed matter from the A. H. Anderson Printing Company.

MR. W. J. BALL, secretary of the Tri-City Electric Company and manager of the Moline (Ill.) branch of the company, has been elected president of the Moline Commercial Club. This is the representative commercial organization of the city, which has a population of about 30,000. Mr. Ball is serving his second term as president of the Illinois State Electrical Contractors' Association. He has served for several terms as president of the Tri-City Electrical Employers' Association, and is a member of the American Institute of Electrical Engineers, Illuminating Engineering Society, Society for Electrical Development, National Electrical Contractors' Association and the Jovian Order. In electing Mr. Ball as president of the Moline Commercial Club the members have selected one of the most active and capable business men in Moline. In addition to his civic and business affiliations he has found time for much community and social work, and has been selected as toastmaster for the annual Alumni banquet which will be held by the Alumni of the local high school.

OBITUARY.

MR. JOSHUA HALE, a Boston electrical engineer, was killed by an automobile at Newburyport, Mass., June 15. He was on his way to the train, and was struck by the car, which was backing away from the station. Mr. Hale was prominent in his home town of Newburyport, and was well known in Moline, Ill., where he once lived. The widow, who was Florence Gould, of Moline, survives.

DATES AHEAD.

Michigan Section, National Electric Light Association. Annual convention cruise, Steamer *Rochester,* June 26 to 30. Secretary, Herbert Silvester, 18 Washington Avenue, Detroit, Mich.

American Institute of Electrical En-

gineers. Annual convention Deer Park Hotel, Deer Park, Md., June 29-July 2. Secretary, F. L. Hutchinson, 29 West Thirty-ninth Street, New York, N. Y.

Ohio Electric Light Association. Annual convention, Cedar Point, O., July 20-23. Secretary, D. L. Gaskill, Greenville, O.

National Electrical Contractors' Association of the United States. Fifteenth annual convention, San Francisco, Cal., July 21-24. Secretary, George H. Duffield, 41 Martin Building, Utica, N. Y.

International Association of Municipal Electricians. Annual meeting, Gibson Hotel, Cincinnati, O., August 24-27. Secretary, C. R. George, Houston, Tex.

Association of Iron and Steel Electrical Engineers. Annual convention, Hotel Statler, Detroit, Mich., September 8-11. Secretary, W. T. Snyder, McKeesport, Pa.

American Electrochemical Society. Twenty-eighth general meeting, San Francisco, Cal., September 16-18. Secretary, Joseph W. Richards, South Bethlehem, Pa.

International Engineering Congress, San Francisco, Cal., September 20-25. Executive secretary, E. J. Dupuy, Foxcroft Building, San Francisco, Cal.

Illuminating Engineering Society. Annual convention, New Willard Hotel, Washington, D. C., September 20-23. Assistant secretary, Joseph Langan, 33 West Thirty-ninth Street, New York, N. Y.

Telephone Pioneers of America. Annual meeting, San Francisco, Cal., September 21-23. Secretary, R. H. Starrett, 15 Dey Street, New York, N. Y.

With the Electrical Manufacturers

L. B. Allen Company, Incorporated, 4517 North Lincoln Street, Chicago, Ill., manufacturer of the well known line of Allen fluxes and soldering tools, announces that it has a very successful soldering flux for aluminum, as well as that for the other metals which have been commonly soldered.

Universal Motor Company, Oshkosh, Wis., has issued bulletin No. 20 describing Universal generator sets. These comprise an internal-combustion engine, either direct-connected or belted to a generator, and are made in various sizes up to three kilowatts capacity. They are designed particularly for rural house and farm lighting, battery charging, boat lighting, wireless telegraphy, etc.

Wagner Electric Manufacturing Company, St. Louis, Mo., has prepared for distribution an attractive wall calendar (13 by 21 inches) covering the period from June, 1914, to June, 1915. The young Wagner mascot is shown appropriately to the season in college cap and gown and pointing to the comet-emphasized comma in the company's slogan "Wagner, Quality." The picture is an attractively colored skyscape.

The R. D. Nuttall Company, Pittsburgh, Pa., has issued catalog No. 13, covering electric-railway gears, pinions and trolleys; it gives general data on Nuttall railway-motor gearing for Westinghouse and General Electric equipments, Nuttall trolleys, harps and wheels, flexible couplings of the spring and buffer type, and electric-railway-compressor gears. The company has also issued catalog No. 12 on mine and industrial gears, pinions and trolleys; this publication covers mine-haulage-locomotive gears, pinions and trolleys, mining-machine gearing, and gives mine-haulage data and general data for ordering industrial gears.

American Sheet & Tin Plate Company, Pittsburgh, Pa., has issued a number of new publications, of which the one entitled "Better Buildings" points out the value of its roofing and siding plates for a great many types of buildings, such as factories, mills, warehouses, garages, barns, train sheds, etc. Data on these products are given, also many valuable suggestions and diagrams on the construction of simple buildings. Another publication describes "Apollo Best Bloom Galvanized Sheets." These are copper-bearing sheets used extensively for the construction of buildings, as well as for culverts. Another publication gives a discussion on the subject of corrosion, prepared by D. M. Buck, metallurgical engineer. This gives an account of a series of tests made with various roofing materials, and shows the superiority of copper-bearing steel. Still another publication is entitled "Copper, Its Effect Upon Steel for Roofing Tin." This also refers to corrosion tests of copper-bearing steel products, and gives data on various sheet materials of this type produced by the company.

Roller-Smith Company, 203 Broadway, New York City, has issued a number of new bulletin sheets for its loose-leaf catalog. No. 71 deals with industrial circuit-breakers ranging from 3 to 100 amperes. Nos. 73 and 74 are devoted to standard circuit-breakers of the plain overload, no-voltage, shunt-trip and combination types. No. 75 describes reverse-current relays. Nos. 81 and 82 cover portable instruments for direct-current and alternating-current circuits, respectively. No. takes up alternating-current switchboard instruments. No. 85 describes Hartmann & Braun vibrating-reed frequency meters of the switchboard, portable and combination types. No. 86 deals with signal-system-testing voltammeters. No. 91 covers several types of direct-current switchboard instruments. No. 92 is devoted to portable ohmmeters, portable Wheatstone bridges and bond testers. Nos. 96, 97 and 98 cover Columbia induction-type switchboard watt-hour meters, commutator-type direct-current watt-hour meters, and shunted astatic direct-current switchboard watt-hour meters, respectively.

Record of Electrical Patents.

Our weekly record of the United States electrical patents issued is based on the *Official Gazette* of the United States Patent Office. Owing to the practical exhaustion of the appropriation for printing the *Gazette* and specifications of patents issued, the *Official Gazette* for June 15, 1915, giving the patents issued on that date, will not be published until after July 1, when the appropriation for the next fiscal year becomes available. Our record of electrical patents of June 15 will therefore appear as early in July as possible.

Patents Expired.

The following United States electrical patents expired on June 21, 1915:

605,835. Electrolytic Production of Amalgams, Etc. E. Andreoli and G. Andreoli, London, England.

605,842. Electrically Heated Charge for Cartridges or Shells. L. W. Bates, Chicago.

605,850. Electric Motor. F. E. Briner, St. Louis, Mo.

605,862. Electric Meter. T. Duncan, Fort Wayne, Ind.

605,913. Telephone Transmitter. F. A. Ray, Boston, Mass.

605,915. Electric Clock-Controlled Switch Mechanism. R. W. Rollins, Hartford, Conn.

605,941. Electric Block-Signal System for Railways. L. C. Werner, Broad Brook, Conn.

605,949. Electric Meter. T. Duncan, Fort Wayne, Ind.

605,953. Controlling Mechanism for Electric Motors. G. Gibbs, W. S. Johnson and H. Winkenwerder, Milwaukee, Wis.

605,956. Controller for Type-Casting and Setting Machines. G. A. Goodson, Minneapolis, Minn.

605,957. Differential Letter-Space Register for Composing Machines. G. A. Goodson.

606,004. Thermal Circuit-Closer. L. Emdin and J. A. Dewson, Reading, Pa.

606,009. Electric Controller. M. W. Hanks, Madison, Wis.

606,012. Electric-Current Controller. J. J. Hogan, New Haven, Conn.

606,015. System of Electrical Distribution and Regulation. B. G. Lamme, Pittsburgh.

606,033. Means for Compensating for Temperature-Resistance Changes. C. F. Scott, Pittsburgh, Pa.

606,056. Alternating-Current Electric Motor. R. H. Hassler, Pittsburgh, Pa.

606,076. Electric Alarm System. A. Ovenden, Akron, O.

606,108. Electric Arc Lamp. F. Wright, Newburgh, N. Y.

606,127. Electrode for Arc Lights. C. S. Dolley, Philadelphia, Pa.

606,162. Telephone-Exchange System. W. W. Dean, St. Louis, Mo.

606,167. Electric Brake. E. W. G. C. Hoffmann, Charlottenburg, Germany.

606,171. Shunt for Electric Circuits. O. B. Shallenberger, Rochester, Pa.